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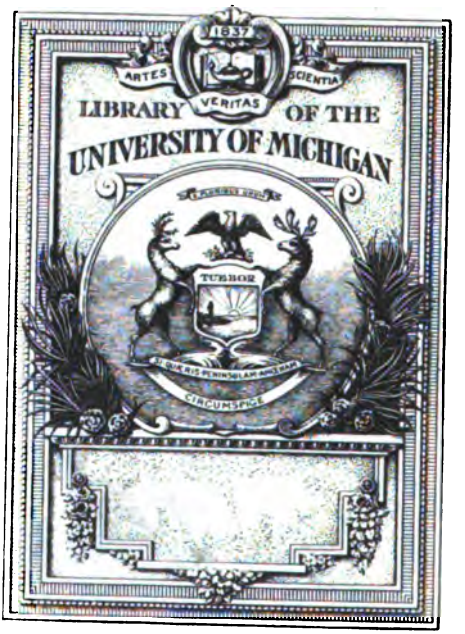
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THE WORKS

OF

GEORGE BERKELEY, D.D.,

BISHOP OF CLOYNE.

INCLUDING

HIS LETTERS TO THOMAS PRIOR, Esq., DEAN GERVAIS, MR. POPE, &c. &c.

TO WHICH IS PREFIXED

AN ACCOUNT OF HIS LIFE.

IN THIS EDITION THE LATIN ESSAYS ARE RENDERED INTO ENGLISH, AND THE "INTRODUCTION TO HUMAN KNOWLEDGE" ANNOTATED,

BY THE

REV. G. N. WRIGHT, M.A.

EDITOR OF THE WORKS OF REID AND STEWART.

IN TWO VOLUMES.

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PASSIVE OBEDIENCE,

OR,

THE CHRISTIAN DOCTRINE OF NOT RESISTING THE SUPREME POWER,

PROVED AND VINDICATED

UPON

THE PRINCIPLES OF THE LAW OF NATURE,

IN A DISCOURSE DELIVERED AT THE COLLEGE CHAPEL.

TO THE READER.

THAT an absolute passive obedience ought not to be paid to any civil power: but that submission to government should be measured and limited by the public good of the society; and that therefore subjects may lawfully resist the supreme authority, in those cases where the public good shall plainly seem to require it: nay, that it is their duty to do so, inasmuch as they are all under an indispensable obligation to promote the common interest; these and the like notions, which I cannot help thinking pernicious to mankind and repugnant to right reason, having of late years been industriously cultivated, and set in the most advantageous lights by men of parts and learning, it seemed necessary to arm the youth of our university against them, and take care they go into the world well principled; I do not mean obstinately prejudiced in favour of a party, but from an early acquaintance with their duty, and the clear rational grounds of it, determined to such practices as may speak them good Christians and loyal subjects.

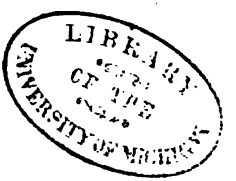
In this view, I made three discourses not many months since in the College-chapel,* which some who heard them thought it might be of use to make more public: and indeed, the false accounts that are gone abroad concerning them, have made it necessary. Accordingly I now send them into the world under the form of one entire discourse.

To conclude; as in writing these thoughts it was my endeavour to preserve that cool and impartial temper which becomes every sincere inquirer after truth, so I heartily wish they may be read with the same disposition.

* Trinity College, Dublin.

PASSIVE OBEDIENCE,

ETC.



ROMANS XIII. 2.

"*Whosoever resisteth the power resisteth the ordinance of God.*"

I. IT is not my design to inquire into the particular nature of the government and constitution of these kingdoms; much less to pretend to determine concerning the merits of the different parties now reigning in the state. Those topics I profess to lie out of my sphere, and they will probably be thought by most men, improper to be treated of in an audience almost wholly made up of young persons, set apart from the business and noise of the world, for their more convenient instruction in learning and piety. But surely it is in no respect unsuitable to the circumstances of this place to inculcate and explain every branch of the law of nature; or those virtues and duties which are equally binding in every kingdom or society of men under heaven; and of this kind I take to be that Christian duty of not resisting the supreme power implied in my text. "Whosoever resisteth the power resisteth the ordinance of God." In treating on which words I shall observe the following method.

II. First I shall endeavour to prove, that there is an absolute, unlimited non-resistance or passive obedience due to the supreme civil power, wherever placed in any nation. Secondly, I shall inquire into the grounds and reasons of the contrary opinion. Thirdly, I shall consider the objections drawn from the pretended consequences of non-resistance to the supreme power. In handling these points I intend not to build on the authority of holy scripture, but altogether on the principles of reason common to all mankind; and that, because there are some very rational and learned men, who being verily persuaded, an absolute passive subjection to any earthly power is repugnant to right reason, can never bring themselves to admit such an interpretation of holy scripture (however natural and obvious from the words) as shall make that a part of Christian religion, which seems to them in itself manifestly absurd, and destructive of the original inherent rights of human nature.

III. I do not mean to treat of that submission which men are either in duty or prudence obliged to pay inferior or executive powers; neither shall I consider where or in what persons the supreme or legislative power is lodged in this or that government. Only thus much I shall take for granted, that there is in every civil community, somewhere or other, placed a supreme power of making laws, and enforcing the observation of them. The fulfilling of those laws, either by a punctual performance of what is enjoined in them, or, if that be inconsistent with reason or conscience, by a patient submission to whatever penalties the supreme power hath annexed to the neglect or transgression of them, is termed loyalty; as on the other hand, the making use of force and open violence, either to withstand the execution of the laws, or ward off the penalties appointed by the supreme power, is properly named rebellion. Now to make it evident, that every degree of rebellion is criminal in the subject; I shall in the first place endeavour to prove that loyalty is a natural or moral duty; and disloyalty or rebellion in the most strict and proper sense, a vice or breach of the law of nature. And secondly, I propose to show that the prohibitions of vice, or negative precepts of the law of nature, as, Thou shalt not commit adultery, Thou shalt not forswear thyself, Thou shalt not resist the supreme power, and the like, ought to be taken in a most absolute, necessary, and immutable sense: insomuch that the attainment of the greatest good, or deliverance from the greatest evil, that can befall any man or number of men in this life, may not justify the least violation of them. First then I am to show that loyalty is a moral duty, and disloyalty or rebellion in the most strict and proper sense a vice, or breach of the law of nature.

IV. Though it be a point agreed amongst all wise men, that there are certain moral rules or laws of nature, which carry with them an eternal and indispensable obligation; yet concerning the proper methods for discovering those laws, and distinguishing them from others dependent on the humour and discretion of men, there are various opinions; some direct us to look for them in the divine ideas, others in the natural inscriptions on the mind; some derive them from the authority of learned men, and the universal agreement and consent of nations. Lastly, others hold that they are only to be discovered by the deductions of reason. The three first methods must be acknowledged to labour under great difficulties, and the last has not, that I know, been any where distinctly explained, or treated of so fully as the importance of the subject doth deserve. I hope therefore it will be pardoned, if in a discourse of passive obedience, in order to lay the foundation of that duty the deeper, we make some inquiry into the origin, nature, and obligation of moral duties in general, and the criterions whereby they are to be known.

V. Self-love being a principle of all others the most universal, and the most deeply engraven in our hearts, it is natural for us to regard things as they are fitted to augment or impair our own happiness; and accordingly we denominate them good or evil. Our judgment is ever employed in distinguishing between these two, and it is the whole business of our lives to endeavour, by a proper application of our faculties, to procure the one and avoid the other. At our first coming into the world we are entirely guided by the impressions of sense, sensible pleasure being the infallible characteristic of present good, as pain is of evil. But by degrees, as we grow up in our acquaintance with the nature of things, experience informs us that present good is afterwards oft attended with a greater evil; and on the other side, that present evil is not less frequently the occasion of procuring to us a greater future good. Besides, as the nobler faculties of the human soul begin to display themselves, they discover to us goods far more excellent than those which affect the senses. Hence an alteration is wrought in our judgments; we no longer comply with the first solicitations of sense, but stay to consider the remote consequences of an action, what good may be hoped, or what evil feared from it, according to the wonted course of things. This obliges us frequently to overlook present momentary enjoyments, when they come in competition with greater and more lasting goods, though too far off, or of too refined a nature to affect our senses.

VI. But as the whole earth, and the entire duration of those perishing things contained in it, is altogether inconsiderable, or in the prophet's expressive style, "less than nothing" in respect of eternity, who sees not that every reasonable man ought so to frame his actions as that they may most effectually contribute to promote his eternal interest? And since it is a truth evident by the light of nature, that there is a sovereign, omniscient Spirit, who alone can make us for ever happy, or for ever miserable: it plainly follows that a conformity to his will, and not any prospect of temporal advantage, is the sole rule whereby every man who acts up to the principles of reason must govern and square his actions. The same conclusion doth likewise evidently result from the relation which God bears to his creatures. God alone is maker and preserver of all things. He is therefore with the most undoubted right the great legislator of the world; and mankind are by all the ties of duty, no less than interest, bound to obey his laws.

VII. Hence we should above all things endeavour to trace out the divine will, or the general design of Providence with regard to mankind, and the methods most directly tending to the accomplishment of that design, and this seems the genuine and proper way for discovering the laws of nature. For laws being rules

directive of our actions to the end intended by the legislator, in order to attain the knowledge of God's laws, we ought first to inquire what that end is, which he designs should be carried on by human actions. Now, as God is a being of infinite goodness, it is plain the end he proposes is good. But God enjoying in himself all possible perfection, it follows that it is not his own good, but that of his creatures. Again, the moral actions of men are entirely terminated within themselves, so as to have no influence on the other orders of intelligences or reasonable creatures: the end therefore to be procured by them, can be no other than the good of men. But as nothing in a natural state can entitle one man more than another to the favour of God, except only moral goodness, which consisting in a conformity to the laws of God, doth presuppose the being of such laws, and law ever supposing an end, to which it guides our actions, it follows that antecedent to the end proposed by God, no distinction can be conceived between men; that end therefore itself, or general design of Providence, is not determined or limited by any respect of persons: it is not therefore the private good of this or that man, nation, or age, but the general well-being of all men, of all nations, of all ages of the world, which God designs should be procured by the concurring actions of each individual. Having thus discovered the great end to which all moral obligations are subordinate; it remains, that we inquire what methods are necessary for the obtaining that end.

VIII. The well-being of mankind must necessarily be carried on one of these two ways: either first, without the injunction of any certain universal rules of morality, only by obliging every one upon each particular occasion to consult the public good, and always to do that which to him shall seem, in the present time and circumstances, most to conduce to it. Or secondly, by enjoining the observation of some determinate, established laws, which, if universally practised, have from the nature of things an essential fitness to procure the well-being of mankind; though in their particular application, they are sometimes, through untoward accidents and the perverse irregularity of human wills, the occasions of great sufferings and misfortunes, it may be, to very many good men. Against the former of these methods there lie several strong objections. For brevity I shall mention only two.

IX. First, it will thence follow, that the best men for want of judgment, and the wisest for want of knowing all the hidden circumstances and consequences of an action, may very often be at a loss how to behave themselves; which they would not be, in case they judged of each action by comparing it with some particular precept, rather than by examining the good or evil which in that single instance it tends to procure: it being far more easy to judge with certainty, whether such or such an action be a

transgression of this or that precept, than whether it will be attended with more good or ill consequences. In short, to calculate the events of each particular action is impossible, and though it were not, would yet take up too much time to be of use in the affairs of life. Secondly, if that method be observed, it will follow that we can have no sure standard, to which comparing the actions of another, we may pronounce them good or bad, virtues or vices. For since the measure and rule of every good man's actions is supposed to be nothing else, but his own private, disinterested opinion, of what makes most for the public good at that juncture: and since this opinion must unavoidably in different men, from their particular views and circumstances, be very different: it is impossible to know, whether any one instance of parricide or perjury, for example, be criminal. The man may have had his reasons for it, and that which in me would have been a heinous sin, may be in him a duty. Every man's particular rule is buried in his own breast, invisible to all but himself, who therefore can only tell whether he observes it or no. And since that rule is fitted to particular occasions, it must ever change as they do: hence it is not only various in different men, but in one and the same man at different times.

X. From all which it follows, there can be no harmony or agreement between the actions of good men: no apparent steadiness or consistency of one man with himself, no adhering to principles: the best actions may be condemned, and the most villanous meet with applause. In a word, there ensues the most horrible confusion of vice and virtue, sin and duty, that can possibly be imagined. It follows therefore that the great end to which God requires the concurrence of human actions, must of necessity be carried on by the second method proposed, namely, the observation of certain, universal, determinate rules or moral precepts, which in their own nature have a necessary tendency to promote the well-being of the sum of mankind, taking in all nations and ages, from the beginning to the end of the world.

XI. Hence upon an equal comprehensive survey of the general nature, the passions, interests, and mutual respects of mankind; whatsoever practical proposition doth to right reason evidently appear to have a necessary connexion with the universal well-being included in it, is to be looked upon as enjoined by the will of God. For he that willeth the end, doth will the necessary means conducive to that end; but it hath been shown, that God willeth the universal well-being of mankind should be promoted by the concurrence of each particular person; therefore every such practical proposition, necessarily tending thereto, is to be esteemed a decree of God, and is consequently a law to man.

XII. These propositions are called laws of nature, because they are universal, and do not derive their obligation from any civil

sanction, but immediately from the author of nature himself. They are said to be stamped on the mind, to be engraven on the tables of the heart, because they are well known to mankind, and suggested and inculcated by conscience. Lastly, they are termed eternal rules of reason, because they necessarily result from the nature of things, and may be demonstrated by the infallible deductions of reason.

XIII. And notwithstanding that these rules are too often, either by the unhappy concurrence of events, or more especially by the wickedness of perverse men, who will not conform to them, made accidental causes of misery to those good men who do; yet this doth not vacate their obligation: they are ever to be esteemed the fixed unalterable standards of moral good and evil; no private interest, no love of friends, no regard to the public good, should make us depart from them. Hence when any doubt arises concerning the morality of an action, it is plain, this cannot be determined by computing the public good, which in that particular case it is attended with, but only by comparing it with the eternal law of reason. He who squares his actions by this rule, can never do amiss, though thereby he should bring himself to poverty, death, or disgrace: no, not though he should involve his family, his friends, his country in all those evils, which are accounted the greatest, and most insupportable to human nature. Tenderness and benevolence of temper are often motives to the best and greatest actions; but we must not make them the sole rule of our actions; they are passions rooted in our nature, and like all other passions must be restrained and kept under, otherwise they may possibly betray us into as great enormities, as any other unbridled lust. Nay, they are more dangerous than other passions, insomuch as they are more plausible, and apt to dazzle and corrupt the mind, with the appearance of goodness and generosity.

XIV. For the illustration of what has been said, it will not be amiss, if from the moral we turn our eyes on the natural world. *Homo ortus est* (says Balbus in Cicero*) *ad mundum contemplandum et imitandum:* and surely it is not possible for free intellectual agents to propose a nobler pattern for their imitation than nature, which is nothing else but a series of free actions, produced by the best and wisest agent. But it is evident that those actions are not adapted to particular views, but all conformed to certain general rules, which being collected from observation, are by philosophers termed laws of nature. And these indeed are excellently suited to promote the general well-being of the creation: but what from casual combinations of events, and what from the voluntary motions of animals, it often falls out that the natural good, not only of private men

* De Natura Deorum, lib. ii.

but of entire cities and nations, would be better promoted by a particular suspension, or contradiction, than an exact observation of those laws. Yet for all that, nature still takes its course; nay, it is plain that plagues, famines, inundations, earthquakes, with an infinite variety of pains and sorrows; in a word, all kinds of calamities, public and private, do arise from a uniform, steady observation of those general laws, which are once established by the author of nature, and which he will not change or deviate from upon any of those accounts, how wise or benevolent soever it may be thought by foolish men to do so. As for the miracles recorded in scripture, they were always wrought for confirmation of some doctrine or mission from God, and not for the sake of the particular natural goods, as health or life, which some men might have reaped from them. From all which it seems sufficiently plain, that we cannot be at a loss which way to determine, in case we think God's own methods the properest to obtain his ends, and that it is our duty to copy after them, so far as the frailty of our nature will permit.

XV. Thus far, in general, of the nature and necessity of moral rules, and the criterion or mark whereby they may be known. As for the particulars, from the foregoing discourse, the principal of them may, without much difficulty, be deduced. It hath been shown, that the law of nature is a system of such rules or precepts, as that if they be all of them, at all times, in all places, and by all men observed, they will necessarily promote the well-being of mankind, so far as it is attainable by human actions. Now let any one who hath the use of reason take but an impartial survey of the general frame and circumstances of human nature, and it will appear plainly to him, that the constant observation of truth, for instance, of justice, and chastity, hath a necessary connexion with their universal well-being; that therefore they are to be esteemed virtues or duties, and that, *thou shalt not forswear thyself, thou shalt not commit adultery, thou shalt not steal,* are so many unalterable moral rules, which, to violate in the least degree, is vice or sin. I say, the agreement of these particular practical propositions, with the definition or criterion premised, doth so clearly result from the nature of things, that it were a needless digression in this place to enlarge upon it. And from the same principle, by the very same reasoning, it follows, that loyalty is a moral virtue, and, *thou shalt not resist the supreme power,* a rule or law of nature, the least breach whereof hath the inherent stain of moral turpitude.

XVI. The miseries inseparable from a state of anarchy are easily imagined. So insufficient is the wit or strength of any single man, either to avert the evils, or procure the blessings of life, and so apt are the wills of different persons to contradict and thwart each other, that it is absolutely necessary, several

independent powers be combined together, under the direction (if I may so speak) of one and the same will, I mean the law of the society. Without this there is no politeness, no order, no peace among men, but the world is one great heap of misery and confusion; the strong as well as the weak, the wise as well as the foolish, standing on all sides exposed to all those calamities, which man can be liable to in a state where he has no other security, than the not being possessed of any thing which may raise envy or desire in another. A state by so much more ineligible than that of brutes, as a reasonable creature hath a greater reflection and foresight of miseries than they. From all which it plainly follows, that loyalty, or submission to the supreme authority, hath, if universally practised in conjunction with all other virtues, a necessary connexion with the well-being of the whole sum of mankind; and by consequence, if the criterion we have laid down be true, it is, strictly speaking, a moral duty, or branch of natural religion. And, therefore, the least degree of rebellion is, with the utmost strictness and propriety, a *sin:* not only in Christians, but also in those who have the light of reason alone for their guide. Nay, upon a thorough and impartial view, this submission will, I think, appear one of the very first and fundamental laws of nature, inasmuch as it is civil government which ordains and marks out the various relations between men, and regulates property, thereby giving scope and laying a foundation for the exercise of all other duties. And, in truth, whoever considers the condition of man, will scarce conceive it possible that the practice of any one moral virtue should obtain, in the naked, forlorn state of nature.

XVII. But since it must be confessed, that in all cases our actions come not within the direction of certain fixed moral rules, it may possibly be still questioned, whether obedience to the supreme power be not one of those exempted cases, and, consequently, to be regulated by the prudence and discretion of every single person, rather than adjusted to the rule of absolute non-resistance. I shall therefore endeavour to make it yet more plain, that, *thou shalt not resist the supreme power*, is an undoubted precept of morality; as will appear from the following considerations. First, then, submission to government is a point *important* enough to be established by a moral rule. Things of insignificant and trifling concern, are, for that very reason, exempted from the rules of morality. But government, on which so much depend the peace, order, and well-being of mankind, cannot surely be thought of too small importance to be secured and guarded by a moral rule. Government, I say, which is itself the principal source under heaven, of those particular advantages, for the procurement and conservation whereof, several unquestionable moral rules were prescribed to men.

XVIII. Secondly, obedience to government is a case *uni-*

versal enough to fall under the direction of a law of nature. Numberless rules there may be for regulating affairs of great concernment, at certain junctures, and to some particular persons or societies, which, notwithstanding, are not to be esteemed moral or natural laws, but may be either totally abrogated or dispensed with; because the private ends they were intended to promote, respect only some particular persons, as engaged in relations not founded in the general nature of man, who, on various occasions, and in different postures of things, may prosecute their own designs by different measures, as in human prudence shall seem convenient. But what relation is there more extensive and universal than that of subject and law? This is confined to no particular age or climate, but universally obtains, at all times, and in all places, wherever men live in a state exalted above that of brutes. It is therefore evident, that the rule, forbidding resistance to the law or supreme power, is not, upon pretence of any defect in point of *universality*, to be excluded from the number of the laws of nature.

XIX. Thirdly, there is another consideration, which confirms the necessity of admitting this rule for a moral or natural law; namely, because the case it regards is of too nice and difficult a nature to be left to the judgment and determination of each private person. Some cases there are so plain and obvious to judge of, that they may safely be trusted to the prudence of every reasonable man; but in all instances, to determine whether a civil law is fitted to promote the public interest; or whether submission or resistance will prove most advantageous in the consequence; or when it is, that the general good of a nation may require an alteration of government, either in its form, or in the hands which administer it: these are points too arduous and intricate, and which require too great a degree of parts, leisure, and liberal education, as well as disinterestedness and thorough knowledge in the particular state of a kingdom, for every subject to take upon him the determination of them. From which it follows, that upon this account also, non-resistance, which, in the main, nobody can deny to be a most profitable and wholesome duty, ought not to be limited by the judgment of private persons to particular occasions, but esteemed a most sacred law of nature.

XX. The foregoing arguments do, I think, make it manifest, that the precept against rebellion is on a level with other moral rules. Which will yet further appear from this fourth and last consideration. It cannot be denied, that right reason doth require some common stated rule or measure, whereby subjects ought to shape their submission to the supreme power; since any clashing or disagreement in this point must unavoidably tend to weaken and dissolve the society. And it is unavoidable, that there should be great clashing, where it is left to the breast of

each individual to suit his fancy with a different measure of obedience. But this common stated measure must be either the general precept forbidding resistance, or else the public good of the whole nation: which last, though it is allowed to be in itself something certain and determinate; yet, forasmuch as men can regulate their conduct only by what appears to them, whether in truth it be what it appears or no; and since the prospects men form to themselves of a country's public good, are commonly as various as its landscapes, which meet the eye in several situations: it clearly follows, that to make the public good the rule of obedience, is in effect not to establish any determinate, agreed, common measure of loyalty, but to leave every subject to the guidance of his own particular mutable fancy.

XXI. From all which arguments and considerations it is a most evident conclusion, that the law prohibiting rebellion is in strict truth a law of nature, universal reason, and morality. But to this, it will perhaps be objected by some, that whatever may be concluded with regard to resistance, from the tedious deductions of reason, yet there is I know not what turpitude and deformity in some actions, which at first blush shows them to be vicious; but they, not finding themselves struck with such a sensible and immediate horror at the thought of rebellion, cannot think it on a level with other crimes against nature. To which I answer, that it is true, there are certain natural antipathies implanted in the soul, which are ever the most lasting and insurmountable; but as custom is a second nature, whatever aversions are from our early childhood continually infused into the mind, give it so deep a stain as is scarce to be distinguished from natural complexion. And as it doth hence follow, that to make all the inward horrors of soul pass for infallible marks of sin, were the way to establish error and superstition in the world: so, on the other hand, to suppose all actions lawful, which are unattended with those starts of nature, would prove of the last dangerous consequence to virtue and morality. For these pertaining to us as men, we must not be directed in respect of them by any emotions in our blood and spirits, but by the dictates of sober and impartial reason. And if there be any, who find they have a less abhorrence of rebellion than of other villanies, all that can be inferred from it is, that this part of their duty was not so much reflected on, or so early and frequently inculcated into their hearts, as it ought to have been. Since without question there are other men who have as thorough an aversion for that, as for any other crime.*

* "Il disait ordinairement qu'il avait un aussi grand eloignement pour ce peché là que pour assassiner le monde, ou pour voler sur les grands chemins, et qu'enfin il n'y avait rien qui fut plus contraire à son naturel." He (M. Pascal) used to say he had as great an abhorrence of rebellion as of murder, or robbing on the highway, and that there was nothing more shocking to his nature. Vie de M. Pascal, page 44.

XXII. Again, it will probably be objected, that submission to government differs from moral duties, in that it is founded in a contract, which upon the violation of its conditions doth of course become void, and in such case rebellion is lawful: it hath not therefore the nature of a sin or crime, which is in itself absolutely unlawful, and must be committed on no pretext whatsoever. Now, passing over all inquiry and dispute concerning the first obscure rise of government, I observe its being founded on a contract may be understood in a twofold sense: either, first, that several independent persons finding the unsufferable inconvenience of a state of anarchy, where every one was governed by his own will, consented and agreed together to pay an absolute submission to the decrees of some certain legislative; which, though sometimes they may bear hard on the subject, yet must surely prove easier to be governed by, than the violent humours and unsteady opposite wills of a multitude of savages. And in case we admit such a compact to have been the original foundation of civil government, it must even on that supposition be held sacred and inviolable.

XXIII. Or secondly, it is meant that subjects have contracted with their respective sovereigns or legislators, to pay, not an absolute, but conditional and limited submission to their laws, that is, upon condition, and so far forth as the observation of them shall contribute to the public good: reserving still to themselves a right of superintending the laws, and judging whether they are fitted to promote the public good or no; and (in case they or any of them think it needful) of resisting the higher powers, and changing the whole frame of government by force: which is a right that all mankind, whether single persons or societies, have over those that are deputed by them. But in this sense a contract cannot be admitted for the ground and measure of civil obedience, except one of these two things be clearly shown: either, first, that such a contract is an express known part of the fundamental constitution of a nation, equally allowed and unquestioned by all as the common law of the land: or, secondly, if it be not express, that it is at least necessarily implied in the very nature or notion of civil polity, which supposes it is a thing manifestly absurd, that a number of men should be obliged to live under an unlimited subjection to civil law, rather than continue wild and independent of each other. But to me it seems most evident, that neither of those points will ever be proved.

XXIV. And till they are proved beyond all contradiction, the doctrine built upon them ought to be rejected with detestation. Since to represent the higher powers as deputies of the people, manifestly tends to diminish that awe and reverence, which all good men should have for the laws and government of their country. And to speak of a conditioned, limited loyalty, and I

know not what vague and undetermined contracts, is a most effectual means to loosen the bands of civil society; than which nothing can be of more mischievous consequence to mankind. But after all, if there be any man, who either cannot or will not see the absurdity and perniciousness of those notions, he would, I doubt not, be convinced with a witness, in case they should once become current, and every private man take it in his head to believe them true, and put them in practice.

XXV. But there still remains an objection, which hath the appearance of some strength against what has been said. Namely, that whereas civil polity is a thing entirely of human institution, it seems contrary to reason to make submission to it part of the law of nature, and not rather of the civil law. For how can it be imagined that nature should dictate or prescribe a natural law about a thing, which depends on the arbitrary humour of men, not only as to its kind or form, which is very various and mutable, but even as to its existence; there being nowhere to be found a civil government set up by nature. In answer to this I observe first, that most moral precepts do presuppose some voluntary actions, or pacts of men, and are nevertheless esteemed laws of nature. Property is assigned, the signification of words ascertained, and matrimony contracted by the agreement and consent of mankind; and for all that it is not doubted, whether theft, falsehood, and adultery, be prohibited by the law of nature. Loyalty, therefore, though it should suppose and be the result of human institutions, may, for all that, be of natural obligation. I say, secondly, that, notwithstanding particular societies are formed by men, and are not in all places alike, as things esteemed natural are wont to be, yet there is implanted in mankind a natural tendency or disposition to a social life. I call it natural because it is universal, and because it necessarily results from the differences which distinguish man from beast: the peculiar wants, appetites, faculties, and capacities of man, being exactly calculated and framed for such a state, insomuch that, without it, it is impossible he should live in a condition in any degree suitable to his nature. And since the bond and cement of society is a submission to its laws, it plainly follows, that this duty hath an equal right with any other to be thought a law of nature. And surely that precept which enjoins obedience to civil laws, cannot itself, with any propriety, be accounted a civil law; it must therefore either have no obligation at all on the conscience, or, if it hath, it must be derived from the universal voice of nature and reason.

XXVI. And thus the first point proposed seems clearly made out: namely, that loyalty is a virtue or moral duty; and disloyalty or rebellion, in the most strict and proper sense, a vice or crime against the law of nature. We are now come to the

second point, which was to show, that the prohibitions of vice, or negative precepts of morality, are to be taken in a most absolute, necessary, and immutable sense; insomuch that the attainment of the greatest good, or deliverance from the greatest evil, that can befall any man or number of men in this life, may not justify the least violation of them. But in the first place, I shall explain the reason of distinguishing between positive and negative precepts, the latter only being included in this general proposition. Now the ground of that distinction may be resolved into this; namely, that very often, either through the difficulty or number of moral actions, or their inconsistence with each other, it is not possible for one man to perform several of them at the same time; whereas it is plainly consistent and possible that any man should, at the same time, abstain from all manner of positive actions whatsoever. Hence it comes to pass, that prohibitions or negative precepts must by every one, in all times and places, be all actually observed: whereas those which enjoin the doing of an action, allow room for human prudence and discretion in the execution of them: it for the most part depending on various accidental circumstances; all which ought to be considered, and care taken that duties of less moment do not interfere with and hinder the fulfilling of those which are more important. And for this reason, if not the positive laws themselves, at least the exercise of them, admits of suspension, limitation, and diversity of degrees. As to the indispensableness of the negative precepts of the law of nature, I shall in its proof offer two arguments; the first from the nature of the thing, and the second from the imitation of God in his government of the world.

XXVII. First then, from the nature of the thing it hath been already shown that the great end of morality can never be carried on, by leaving each particular person to promote the public-good, in such a manner as he shall think most convenient, without prescribing certain determinate, universal rules to be the common measure of moral actions: and, if we allow the necessity of these, and at the same time think it lawful to transgress them, whenever the public good shall seem to require it, what is this but in words indeed to enjoin the observation of moral rules, but in effect to leave every one to be guided by his own judgment? than which nothing can be imagined more pernicious and destructive to mankind, as hath been already proved. Secondly, this same point may be collected from the example set us by the author of nature, who, as we have above observed, acts according to certain fixed laws, which he will not transgress upon the account of accidental evils arising from them. Suppose a prince, on whose life the welfare of a kingdom depends, to fall down a precipice, we have no reason to think that the universal law of gravitation would be suspended in that case. The like

may be said of all other laws of nature, which we do not find to admit of exceptions on particular accounts.

XXVIII. And as, without such a steadiness in nature we should soon, instead of this beautiful frame, see nothing but a disorderly and confused chaos: so if once it become current, that the moral actions of men are not to be guided by certain definite, inviolable rules, there will be no longer found that beauty, order, and agreement, in the system of rational beings, or moral world, which will then be all covered over with darkness and violence. It is true he who stands close to a palace can hardly make a right judgment of the architecture and symmetry of its several parts, the nearer ever appearing disproportionably great. And if we have a mind to take a fair prospect of the order and general well-being which the inflexible laws of nature and morality derive on the world, we must, if I may so say, go out of it, and imagine ourselves to be distant spectators of all that is transacted and contained in it; otherwise we are sure to be deceived by the too near view of the little present interests of ourselves, our friends, or our country. The right understanding of what hath been said will, I think, afford a clear solution to the following difficulties.

XXIX. First, it may perhaps seem to some that in consequence of the foregoing doctrine, men will be left to their own private judgments as much as ever. For, first, the very being of the laws of nature; secondly, the criterion whereby to know them; and, thirdly, the agreement of any particular precept with that criterion, are all to be discovered by reason and argumentation, in which every man doth necessarily judge for himself: hence upon that supposition there is place for as great confusion, unsteadiness, and contrariety of opinions and actions, as upon any other. I answer, that however men may differ, as to what were most proper and beneficial to the public to be done or omitted on particular occasions, when they have for the most part narrow and interested views; yet in general conclusions, drawn from an equal and enlarged view of things, it is not possible there should be so great, if any, disagreement at all amongst candid, rational inquirers after truth.

XXX. Secondly, the most plausible pretence of all against the doctrine we have premised concerning a rigid, indispensable observation of moral rules, is that which is founded on the consideration of the public weal: for since the common good of mankind is confessedly the end which God requires should be promoted by the free actions of men, it may seem to follow that all good men ought ever to have this in view, as the great mark to which all their endeavours should be directed; if therefore in any particular case a strict keeping to the moral rule shall prove manifestly inconsistent with the public good, it may be thought

agreeable to the will of God that in that case the rule does restrain an honest disinterested person from acting for that end to which the rule itself was ordained. For it is an axiom that the end is more excellent than the means, which, deriving their goodness from the end, may not come in competition with it.

XXXI. In answer to this, let it be observed, that nothing is a law merely because it conduceth to the public good, but because it is decreed by the will of God, which alone can give the sanction of a law of nature to any precept: neither is any thing, how expedient or plausible soever, to be esteemed lawful on any other account, than its being coincident with, or not repugnant to, the laws promulgated by the voice of nature and reason. It must indeed be allowed, that the rational deduction of those laws is founded in the intrinsic tendency they have to promote the well-being of mankind, on condition they are universally and constantly observed. But though it afterwards comes to pass, that they accidentally fail of that end, or even promote the contrary, they are nevertheless binding, as hath been already proved. In short, that whole difficulty may be resolved by the following distinction. In framing the general laws of nature, it is granted, we must be entirely guided by the public good of mankind, but not in the ordinary moral actions of our lives. Such a rule, if universally observed, hath, from the nature of things, a necessary fitness to promote the general well-being of mankind: therefore it is a law of nature. This is good reasoning. But if we should say, such an action doth in this instance produce much good, and no harm to mankind; therefore it is lawful: this were wrong. The rule is framed with respect to the good of mankind; but our practice must be always shaped immediately by the rule. They who think the public good of a nation to be the sole measure of the obedience due to the civil power, seem not to have considered this distinction.

XXXII. If it be said that some negative precepts, e. g. thou shalt not kill, do admit of limitation, since otherwise it were unlawful for the magistrate, for a soldier in a battle, or a man in his own defence, to kill another: I answer, when a duty is expressed in too general terms, as in this instance, in order to a distinct declaration of it, either those terms may be changed for others of a more limited sense, as *kill* for *murder*, or else from the general proposition remaining in its full latitude, exceptions may be made of those precise cases, which, not agreeing with the notion of murder, are not prohibited by the law of nature. In the former case there is a limitation, but it is only of the signification of a single term too general and improper, by substituting another more proper and particular in its place. In the latter case there are exceptions, but then they are not from the law of nature, but from a more general proposition, which

besides that law, includes somewhat more, which must be taken away in order to leave the law by itself clear and determinate. From neither of which concessions will it follow, that any negative law of nature is limited to those cases only where its particular application promotes the public good, or admits all other cases to be excepted from it, wherein its being actually observed produceth harm to the public. But of this I shall have occasion to say more in the sequel. I have now done with the first head, which was to show, that there is an absolute, unlimited passive obedience due to the supreme power, wherever placed in any nation; and come to inquire into the grounds and reasons of the contrary opinion: which was the second thing proposed.

XXXIII. One great principle, which the pleaders for resistance make the ground-work of their doctrine, is, that the law of self-preservation is prior to all other engagements, being the very first and fundamental law of nature. Hence, say they, subjects are obliged by nature, and it is their duty, to resist the cruel attempts of tyrants, however authorized by unjust and bloody laws, which are nothing else but the decrees of men, and consequently must give way to those of God or nature. But perhaps, if we narrowly examine this notion, it will not be found so just and clear as some men may imagine, or, indeed, as at first sight it seems to be. For we ought to distinguish between a twofold signification of the terms law of nature; which words do either denote a rule or precept for the direction of the voluntary actions of reasonable agents, and in that sense they imply a duty; or else they are used to signify any general rule, which we observe to obtain in the works of nature, independent of the wills of men; in which sense no duty is implied. And in this last acceptation, I grant it is a general law of nature, that in every animal there be implanted a desire of self-preservation, which though it is the earliest, the deepest, and most lasting of all, whether natural or acquired appetites, yet cannot with any propriety be termed a moral duty. But if in the former sense of the words, they mean that self-preservation is the first and most fundamental law of nature, which therefore must take place of all other natural or moral duties: I think that assertion to be manifestly false, for this plain reason, because it would thence follow, a man may lawfully commit any sin whatsoever to preserve his life, than which nothing can be more absurd.

XXXIV. It cannot indeed be denied, that the law of nature restrains us from doing those things which may injure the life of any man, and consequently our own. But, notwithstanding all that is said of the obligativeness and priority of the law of self-preservation, yet, for aught I can see, there is no particular law which obliges any man to prefer his own temporal good, not even life itself, to that of another man, much less to the observa-

tion of any one moral duty. This is what we are too ready to perform of our own accord; and there is more need of a law to curb and restrain, than there is of one to excite and inflame our self-love.

XXXV. But, secondly, though we should grant the duty of self-preservation to be the first and most necessary of all the positive or affirmative laws of nature; yet, forasmuch as it is a maxim allowed by all moralists, that evil is never to be committed, to the end good may come of it, it will thence plainly follow, that no negative precept ought to be transgressed for the sake of observing a positive one; and therefore, since we have shown 'thou shalt not resist the supreme power' to be a negative law of nature, it is a necessary consequence, that it may not be transgressed under pretence of fulfilling the positive duty of self-preservation.

XXXVI. A second erroneous ground of our adversaries, whereon they lay a main stress, is that they hold the public good of a particular nation to be the measure of the obedience due from the subject to the civil power, which therefore may be resisted whensoever the public good shall verily seem to require it. But this point hath been already considered, and in truth it can give small difficulty to whoever understands loyalty to be on the same foot with other moral duties enjoined in negative precepts, all which, though equally calculated to promote the general well-being, may not nevertheless be limited or suspended under pretext of giving way to the end, as is plain from what hath been premised on that subject.

XXXVII. A third reason which they insist on, is to this effect. All civil authority or right is derived originally from the people: but nobody can transfer that to another, which he hath not himself; therefore, since no man hath an absolute, unlimited right over his own life, the subject cannot transfer such a right to the prince (or supreme power), who consequently hath no such unlimited right to dispose of the lives of his subjects. In case therefore a subject resist his prince, who, acting according to law, maketh an unjust, though legal attempt on his life, he does him no wrong; since wrong it is not, to prevent another from seizing what he hath no right to: whence it should seem to follow, that agreeably to reason, the prince, or supreme power, wheresoever placed, may be resisted. Having thus endeavoured to state their argument in its clearest light, I make this answer. First, it is granted, no civil power hath an unlimited right to dispose of the life of any man. Secondly, in case one man resist another invading that which he hath no right to, it is granted he doth him no wrong. But in the third place, I deny that it doth thence follow, the supreme power may consonantly to reason be resisted; because that although such resistance wronged not the prince or

supreme power wheresoever placed, yet it were injurious to the author of nature, and a violation of his law, which reason obligeth us to transgress upon no account whatsoever, as hath been demonstrated.

XXXVIII. A fourth mistake or prejudice which influenceth the impugners of non-resistance, arises from the natural dread of slavery, chains, and fetters, which inspires them with an aversion for any thing which even metaphorically comes under those denominations. Hence they cry out against us that we would deprive them of their natural freedom, that we are making chains for mankind, that we are for enslaving them, and the like. But how harsh soever the sentence may appear, yet it is most true, that our appetites, even the most natural, as of ease, plenty, or life itself, must be chained and fettered by the laws of nature and reason. This slavery, if they will call it so, or subjection of our passions to the immutable decrees of reason, though it may be galling to the sensual part, or the beast, yet sure I am, it addeth much to the dignity of that which is peculiarly human in our composition. This leads me to the fifth fundamental error.

XXXIX. Namely, the mistaking the object of passive obedience. We should consider, that when a subject endures the insolence and oppression of one or more magistrates, armed with the supreme civil power, the object of his submission is, in strict truth, nothing else but right reason, which is the voice of the author of nature. Think not we are so senseless, as to imagine tyrants cast in a better mould than other men: no, they are the worst and vilest of men, and for their own sakes have not the least right to our obedience. But the laws of God and nature must be obeyed, and our obedience to them is never more acceptable and sincere, than when it exposeth us to temporal calamities.

XL. A sixth false ground of persuasion to those we argue against, is their not distinguishing between the natures of positive and negative duties. For, say they, since our active obedience to the supreme civil power is acknowledged to be limited, why may not our duty of non-resistance be thought so too? The answer is plain; because positive and negative moral precepts are not of the same nature, the former admitting such limitations and exceptions as the latter are on no account liable to, as hath been already proved. It is very possible that a man in obeying the commands of his lawful governors, might transgress some law of God contrary to them; which it is not possible for him to do, merely by a patient suffering and non-resistance for conscience sake. And this furnishes such a satisfactory and obvious solution of the forementioned difficulty, that I am not a little surprised to see it insisted on, by men, otherwise, of good sense and reason. And so much for the grounds and reasons

of the adversaries of non-resistance. I now proceed to the third and last thing proposed, namely, the consideration of the objections drawn from the pretended consequences of non-resistance.

XLI. First then it will be objected, that in consequence of that notion, we must believe that God hath, in several instances, laid the innocent part of mankind under an unavoidable necessity of enduring the greatest sufferings and hardships without any remedy; which is plainly inconsistent with the divine wisdom and goodness: and therefore the principle from whence that consequence flows, ought not to be admitted as a law of God or nature. In answer to which I observe, we must carefully distinguish between the necessary and accidental consequences of a moral law. The former kind are those which the law is in its own nature calculated to produce, and which have an inseparable connexion with the observation of it; and indeed if these are bad, we may justly conclude the law to be so too, and consequently not from God. But the accidental consequences of a law have no intrinsic natural connexion with, nor do they, strictly speaking, flow from its observation, but are the genuine result of something foreign and circumstantial, which happens to be joined with it. And these accidental consequences of a very good law may nevertheless be very bad; which badness of theirs is to be charged on their own proper and necessary cause, and not on the law, which hath no essential tendency to produce them. Now though it must granted, that a lawgiver infinitely wise and good will constitute such laws for the regulation of human actions, as have in their own nature a necessary inherent aptness to promote the common good of all mankind, and that in the greatest degree that the present circumstances and capacities of human nature will admit; yet we deny that the wisdom and goodness of the lawgiver are concerned, or may be called in question, on account of the particular evils which arise, necessarily and properly, from the transgression of some one or more good laws, and but accidentally from the observation of others. But it is plain that the several calamities and devastations, which oppressive governments bring on the world, are not the genuine, necessary effects of the law, that enjoineth a passive subjection to the supreme power, neither are they included in the primary intention thereof, but spring from avarice, ambition, cruelty, revenge, and the like inordinate affections and vices raging in the breasts of governors. They may not therefore argue a defect of wisdom or goodness in God's law, but of righteousness in men.

XLII. Such is the present state of things, so irregular are the wills, and so unrestrained the passions of men, that we every day see manifest breaches and violations of the laws of nature, which being always committed in favour of the wicked, must surely be

sometimes attended with heavy disadvantages and miseries, on the part of those who by a firm adhesion to his laws endeavour to approve themselves in the eyes of their Creator. There are, in short, no rules of morality, not excepting the best, but what may subject good men to great sufferings and hardships, which necessarily follows from the wickedness of those they have to deal with, and but accidentally from those good rules. And as on the one hand it were inconsistent with the wisdom of God, by suffering a retaliation of fraud, perjury, or the like, on the head of offenders, to punish one transgression by another: so on the other hand, it were inconsistent with his justice, to leave the good and innocent a hopeless sacrifice to the wicked. God therefore hath appointed a day of retribution in another life, and in this we have his grace and a good conscience for our support. We should not therefore repine at the divine laws, or show a frowardness or impatience of those transient sufferings they accidentally expose us to, which, however grating to flesh and blood, will yet seem of small moment, if we compare the littleness and fleetingness of this present world with the glory and eternity of the next.

XLIII. From what hath been said I think it is plain, that the premised doctrine of non-resistance were safe, though the evils incurred thereby should be allowed never so great. But perhaps upon a strict examination they will be found much less than by many they are thought to be. The mischievous effects which are charged on that doctrine may be reduced to these two points. First, that it is an encouragement for all governors to become tyrants, by the prospect it gives them of impunity or non-resistance. Secondly, that it renders the oppression and cruelty of those who are tyrants, more insupportable and violent, by cutting off all opposition, and consequently all means of redress. I shall consider each of these distinctly. As to the first point, either you will suppose the governors to be good or ill men. If they are good, there is no fear of their becoming tyrants. And if they are ill men, that is, such as postpone the observation of God's laws to the satisfying of their own lusts, then it can be no security to them, that others will rigidly observe those moral precepts, which they find themselves so prone to transgress.

XLIV. It is indeed a breach of the law of nature for a subject, though under the greatest and most unjust sufferings, to lift up his hand against the supreme power. But it is a more heinous and inexcusable violation of it, for the persons invested with the supreme power, to use that power to the ruin and destruction of the people committed to their charge. What encouragement therefore can any man have to think that others will not be pushed on by the strong implanted appetite of self-preservation, to commit a crime, when he himself commits a more brutish and

unnatural crime, perhaps without any provocation at all? Or is it to be imagined that they who daily break God's laws, for the sake of some little profit or transient pleasure, will not be tempted by the love of property, liberty, or life itself, to transgress that single precept which forbids resistance to the supreme power?

XLV. But it will be demanded, to what purpose then is this duty of non-resistance preached, and proved, and recommended to our practice, if in all likelihood, when things come to an extremity, men will never observe it? I answer, to the very same purpose that any other duty is preached. For what duty is there which many, too many, upon some consideration or other, may not be prevailed on to transgress? Moralists and divines do not preach the duties of nature and religion, with the view of gaining mankind to a perfect observation of them; that they know is not to be done. But, however, our pains are answered, if we can make men less sinners than otherwise they would be; if by opposing the force of duty to that of present interest and passion, we can get the better of some temptations, and balance others, while the greatest still remain invincible.

XLVI. But granting those who are invested with the supreme power to have all imaginable security, that no cruel and barbarous treatment whatever could provoke their subjects to rebellion: yet I believe it may be justly questioned, whether such security would tempt them to more or greater acts of cruelty, than jealousy, distrust, suspicion, and revenge may do in a state less secure. And so far in consideration of the first point, namely, that the doctrine of non-resistance is an encouragement for governors to become tyrants.

XLVII. The second mischievous effect it was charged with, is, that it renders the oppression and cruelty of those who are tyrants more insupportable and violent, by cutting off all opposition, and consequently all means of redress. But, if things are rightly considered, it will appear, that redressing the evils of government by force, is at best a very hazardous attempt, and what often puts the public in a worse state than it was before. For either you suppose the power of the rebels to be but small, and easily crushed, and then this is apt to inspire the governors with confidence and cruelty. Or, in case you suppose it more considerable, so as to be a match for the supreme power supported by the public treasure, forts, and armies, and that the whole nation is engaged in a civil war; the certain effects of this are rapine, bloodshed, misery, and confusion to all orders and parties of men, greater and more insupportable by far, than are known under any the most absolute and severe tyranny upon earth. And it may be that after much mutual slaughter, the rebellious party will prevail. And if they do prevail to destroy the government in being, it may be they will substitute a better in its place,

or change it into better hands. And may not this come to pass without the expense, and toil, and blood of war? Is not the heart of a prince in the hand of God? may he not therefore give him a right sense of his duty, or may he not call him out of the world by sickness, accident, or the hand of some desperate ruffian, and send a better in his stead? When I speak as of a monarchy, I would be understood to mean all sorts of government, wheresoever the supreme power is lodged. Upon the whole, I think we may close with the heathen philosopher, who thought it the part of a wise man, never to attempt the change of government by force, when it could not be mended without the slaughter and banishment of his countrymen: but to sit still, and pray for better times.* For this way may do, and the other may not do; there is uncertainty in both courses. The difference is, that in the way of rebellion we are sure to increase the public calamities, for a time at least, though we are not sure of lessening them for the future.

XLVIII. But though it should be acknowledged, that in the main, submission and patience ought to be recommended: yet, men will be still apt to demand, whether extraordinary cases may not require extraordinary measures; and therefore in case the oppression be insupportable, and the prospect of deliverance sure, whether rebellion may not be allowed of? I answer, by no means. Perjury, or breach of faith, may, in some possible cases, bring great advantage to a nation, by freeing it from conditions inconsistent with its liberty and public welfare. So likewise may adultery, by procuring a domestic heir, prevent a kingdom's falling into the hands of a foreign power, which would in all probability prove its ruin. Yet will any man say, the extraordinary nature of those cases can take away the guilt of perjury and adultery? This is what I will not suppose.† But it hath been shown, that rebellion is as truly a crime against nature and reason as either of the foregoing, it may not therefore be justified upon any account whatever, any more than they.

* Plato in Epist. 7.

† When I wrote this, I could not think any man would avow the justifying those crimes on any pretext: but I since find that an author (supposed the same who published the book entitled, The Rights of the Christian Church), in a discourse concerning obedience to the supreme powers, printed with three other discourses at London, in the year 1709, ch. 4, p. 28, speaking of divine laws, is not ashamed to assert, "there is no law which wholly relates to man, but ceases to oblige, if upon the infinite variety of circumstances attending human affairs, it happens to be contrary to the good of man." So that, according to this writer, parricide, incest, or breach of faith, become innocent things, if, in the infinite variety of circumstances, they should happen to promote (or be thought by any private person to promote) the public good. After what has been already said, I hope I need not be at any pains to convince the reader of the absurdity and perniciousness of this notion. I shall only observe, that it appears the author was led into it by a more than ordinary aversion to passive obedience, which put him upon measuring or limiting that duty, and, with equal reason, all others, by the public good, to the entire unhinging of all order and morality among men. And it must be owned the transition was very natural.

XLIX. What! must we then submit our necks to the sword? and is there no help, no refuge against extreme tyranny established by law? In answer to this, I say in the first place, it is not to be feared that men in their wits should seek the destruction of their people, by such cruel and unnatural decrees as some are forward to suppose. I say, secondly, that in case they should, yet most certainly the subordinate magistrates may not, nay, they ought not, in obedience to those decrees, to act any thing contrary to the express laws of God. And perhaps, all things considered, it will be thought, that representing this limitation of their active obedience by the laws of God or nature, as a duty to the ministers of the supreme power, may prove in those extravagant supposed cases no less effectual for the peace and safety of a nation, than preaching up the power of resistance to the people.

L. Further it will probably be objected as an absurdity in the doctrine of passive obedience, that it enjoineth subjects a blind, implicit submission to the decrees of other men; which is unbecoming the dignity and freedom of reasonable agents; who indeed ought to pay obedience to their superiors, but it should be a rational obedience, such as arises from a knowledge of the equity of their laws, and the tendency they have to promote the public good. To which I answer, that it is not likely a government should suffer much for want of having its laws inspected and amended, by those who are not legally entitled to a share in the management of affairs of that nature. And it must be confessed, the bulk of mankind are by their circumstances and occupations so far unqualified to judge of such matters, that they must necessarily pay an implicit deference to some or other, and to whom so properly as to those invested with the supreme power?

LI. There is another objection against absolute submission which I should not have mentioned but that I find it insisted on by men of so great note as Grotius and Puffendorf,* who think our non-resistance should be measured by the intention of those who first framed the society. Now, say they, if we suppose the question put to them whether they meant to lay every subject under a necessity of choosing death, rather than in any case to resist the cruelty of his superiors, it cannot be imagined they would answer in the affirmative. For this were to put themselves in a worse condition than that which they endeavoured to avoid by entering into society. For although they were before obnoxious to the injuries of many, they had nevertheless the power of resisting them. But now they are bound, without any opposition at all, to endure the greatest injuries from those whom they have armed with their own strength. Which is by so much worse than the former state, as the undergoing an execution is

* Grotius de Jure Belli et Pacis, lib. i. c. iv. § 7, and Puffendorf de Jure Naturæ et Gentium, lib. vii. c. viii. § 7.

worse than the hazard of a battle. But (passing by all other exceptions which this method of arguing may be liable to) it is evident that a man had better be exposed to the absolute, irresistible decrees, even of one single person, whose own and posterity's true interest it is to preserve him in peace and plenty, and protect him from the injuries of all mankind beside, than remain an open prey to the rage and avarice of every wicked man upon earth, who either exceeds him in strength or takes him at an advantage. The truth of this is confirmed, as well by the constant experience of the far greater part of the world, as by what we have already observed concerning anarchy, and the inconsistence of such a state with that manner of life which human nature requires. Hence it is plain the objection last mentioned is built on a false supposition; viz. That men, by quitting the natural state of anarchy for that of absolute non-resisting obedience to government, would put themselves in a worse condition than they were in before.

LII. The last objection I shall take notice of is, that in pursuance of the premised doctrine, where no exceptions, no limitations are to be allowed of, it should seem to follow men were bound to submit without making any opposition to usurpers, or even madmen possessed of the supreme authority. Which is a notion so absurd and repugnant to common sense, that the foundation on which it is built may justly be called in question. Now in order to clear this point I observe the limitation of moral duties may be understood in a twofold sense, either first as a distinction applied to the terms of a proposition, whereby that which was expressed before too generally is limited to a particular acceptation: and this, in truth, is not so properly limiting the duty as defining it. Or, secondly, it may be understood as a suspending the observation of a duty for avoiding some extraordinary inconvenience, and thereby confining it to certain occasions. And in this last sense only, we have shown negative duties not to admit of limitation. Having premised this remark, I make the following answer to the objection. Namely, that by virtue of the duty of non-resistance, we are not obliged to submit the disposal of our lives and fortunes to the discretion either of madmen or of all those who by craft or violence invade the supreme power. Because the object of the submission enjoined subjects by the law of nature is, from the reason of the thing, manifestly limited so as to exclude both the one and the other. Which I shall not go about to prove, because I believe nobody has denied it. Nor doth the annexing such limits to the object of our obedience, at all limit the duty itself in the sense we except against.

LIII. In morality the eternal rules of action have the same immutable, universal truth with propositions in geometry. Neither of them depend on circumstances or accidents, being at all

times and in all places, without limitation or exception, true. 'Thou shalt not resist the supreme civil power' is no less constant and unalterable a rule, for modelling the behaviour of a subject toward the government, than 'multiply the height by half the base,' is for measuring a triangle. And as it would not be thought to detract from the universality of this mathematical rule that it did not exactly measure a field which was not an exact triangle, so ought it not to be thought an argument against the universality of the rule prescribing passive obedience, that it does not reach a man's practice in all cases where a government is unhinged, or the supreme power disputed. There must be a triangle, and you must use your senses to know this, before there is room for applying your mathematical rule. And there must be a civil government, and you must know in whose hands it is lodged, before the moral precept takes place. But where the supreme power is ascertained, we should no more doubt of our submission to it than we would doubt of the way to measure a figure we know to be a triangle.

LIV. In the various changes and fluctuations of government it is impossible to prevent that controversies should sometimes arise concerning the seat of the supreme power. And in such cases subjects cannot be denied the liberty of judging for themselves, or of taking part with some and opposing others, according to the best of their judgments; all which is consistent with an exact observation of their duty, so long as, when the constitution is clear in the point, and the object of their submission undoubted, no pretext of interest, friends, or the public good, can make them depart from it. In short, it is acknowledged that the precept enjoining non-resistance is limited to particular objects, but not to particular occasions. And in this it is like all other moral negative duties, which, considered as general propositions, do admit of limitations and restrictions, in order to a distinct definition of the duty; but what is once known to be a duty of that sort, can never become otherwise by any good or ill effect, circumstance, or event whatsoever. And in truth if it were not so, if there were no general inflexible rules, but all negative as well as positive duties might be dispensed with, and warped to serve particular interests and occasions, there were an end of all morality.

LV. It is therefore evident, that as the observation of any other negative moral law is not to be limited to those instances only, where it may produce good effects; so neither is the observation of non-resistance limited in such sort, as that any man may lawfully transgress it, whensoever, in his judgment, the public good of his particular country shall require it. And it is with regard to this limitation by the effects, that I speak of non-resistance as an absolute, unconditioned, unlimited duty.

Which must inevitably be granted, unless one of these three things can be proved; either first, that non-resistance is no moral duty: or secondly, that other negative moral duties are limited by the effects: or lastly, that there is something peculiar in the nature of non-resistance, which necessarily subjects it to such a limitation, as no other negative moral duty can admit. The contrary to each of which points, if I mistake not, hath been clearly made out.

LVI. I have now briefly gone through the objections drawn from the consequences of non-resistance, which was the last general head I proposed to treat of. In handling this and the other points, I have endeavoured to be as full and clear, as the usual length of these discourses would permit, and throughout to consider the argument with the same indifference, as I should any other part of general knowledge, being verily persuaded that men as Christians are obliged to the practice of no one moral duty, which may not abide the severest test of reason.

ARITHMETIC

DEMONSTRATED WITHOUT EUCLID OR ALGEBRA.

TO WHICH ARE ADDED,

SOME THOUGHTS CONCERNING SURDS, THE ATMOSPHERIC TIDE, AND THE ALGEBRAIC GAME.

BY * * * * BACHELOR OF ARTS,

TRINITY COLLEGE, DUBLIN.

DEDICATION.

To that very promising youth, WILLIAM PALLISER, the only son of the most reverend the ARCHBISHOP of CASHEL, endowed with genius, sagacity, and learning beyond his years, and born with every quality suited to afford some great light and increase to the sciences, this treatise on arithmetic is, as a small pledge of devoted attachment, offered and dedicated by

THE AUTHOR.

PREFACE.

I PERCEIVE and regret, that most votaries of mathematical science are blindfolded on the very threshold. Inasmuch as the mode of learning mathematics, at least with us, first to apply to arithmetic, then geometry, then algebra; and as we read Tacquet's arithmetic, which no one can thoroughly understand without having some knowledge of algebra, it hence happens, that most students in mathematics, whilst they carefully and successfully master the demonstrations of theorems of inferior utility, leave untouched the principles and reasonings of arithmetical operations, though these last are of such efficacy and value, that they give the most important aid, not only to other branches of mathematics, but to the interests of men of all denominations. Wherefore if any one, after a mathematical course, turn his attention back to Tacquet's work, he will observe many things demonstrated in an obscure manner, so as not so much to enlighten as to force conviction on the mind, being environed with a repulsive array of porisms and theorems.

Nor has any one else, that I am aware of, demonstrated the rules of arithmetic without the aid of algebra. Thinking, then, that it would be of service to beginners if I should set forth my thoughts on these subjects, I now publish them, after they have almost all been kept by me for nearly three years. Now as I have not only given the rules for working questions, but also the demonstrations of those rules, drawn from the proper and genuine principles of arithmetic, some will perhaps be surprised that this treatise is of less size than the common works on arithmetic, though they contain merely the practice. The reason of this is that I have been very brief, both as regards precept and example, in explaining the "wherefore" of operations, on which writers on arithmetic are, in general, very tedious: and yet this brevity, as I hope, has not caused any obscurity. For although the blind require that a guide should lead them by the hand at every step, yet for one proceeding by the clear light of demonstration, it is sufficient to be furnished with even a slender clue. Wherefore I am anxious, that all votaries of ma-

thematics should apply their minds to master the reasons and grounds of the rules of arithmetic.

This is not so difficult as some might suppose. The demonstrations here brought forward are, if I mistake not, easy at once and concise, nor are the principles drawn from any other quarter; nothing borrowed from algebra or Euclid is taken for granted here; I always prefer to prove an operation by obvious and familiar reasoning *à priori*, than to have recourse to an *argumentum ad absurdum*, by means of a tedious chain of consecutive demonstrations. I have endeavoured to derive the theory of square and cube roots from the nature itself of arithmetical involution, which, in my opinion, seems better suited to explain complicated extraction of roots, than what is generally applied to this purpose from the second book of Euclid, or from the analysis of algebraical powers. The common rule for the alligation of various things is demonstrated with difficulty and in particular instances. I have therefore substituted for it one of my own, which scarcely needs demonstration. I have rejected "the rule of false," as it is ineffectual and nearly useless.

I have copied no one; I have trespassed on the intellectual stores of none. For my original purpose was to deduce the rules of arithmetical operations from their principles for my own amusement and exercise, and so to employ my leisure hours. I could not on this occasion, without justly incurring the charge of ingratitude, omit mention of the name of the Rev. John Hall, doctor of divinity, Vice-Provost of this college, and the worthy professor of Hebrew. To that excellent man I acknowledge my obligations on many accounts, and not the least, that by his exhortations I was excited to the delightful study of mathematics.

I have now explained my aim: impartial judges will decide how far I have attained it. To their candid examination I cheerfully submit these first-fruits of my studies, little regarding what sciolists or the malignant may think.

ARITHMETIC.

PART I.

CHAPTER I.

OF NOTATION AND THE STATEMENT OF NUMBERS.

THERE are nine numeral signs 1, 2, 3, 4, 5, 6, 7, 8, 9, employed with the cypher (0) for expressing unlimited classes of numbers. The whole of this contrivance depends on the value of these signs increasing in a tenfold proportion. The series of numbers rising in value according to that law is divided into members or periods for convenience of statement. The subjoined table will completely explain this,

Series of Numeral Signs.

Hundreds Tens Units	349	of Quintillions.
Hundreds Tens Units	758	Quadrillions.
Hundreds Tens Units	192	Trillions.
Hundreds Tens Units	003	Billions.
Hundreds Tens Units	506	Millions.
Hundreds Tens Units	789	Thousands.
Hundreds Tens Units Unesimal	047	Integers.
Decimal Centesimal	32	Parts.
Unesimal Decimal Centesimal	588	Thousandths.
Unesimal Decimal Centesimal	818	Millionths.
Unesimal Decimal Centesimal	300	Billionths.
Unesimal Decimal Centesimal	052	Trillionths.
Unesimal Decimal Centesimal	704	Quadrillionths.

in which is exhibited a series of numeral signs, set forth by threes, the members or periods advancing in thousandfold proportion, and the places in tenfold proportion. For instance, the figure in the units place, and marked by a point placed under it, denotes seven individuals, integral, or considered at least as integral; the next number on the right hand, three tenth parts of that integer, and the number which immediately precedes it denotes four tens of the same integers, and in this tenfold proportion each place exceeds that following it, and is exceeded by that preceding it.

Still further, since by an infinite multiplication and division of units, the series of signs is infinitely extended in each direction, from the units place, and so innumerable places for expressing their exact value, there is need merely of the continual repetition of three numbers, provided that each collection of threes, or period, be designated by its own name, as is the case in the table; for, in proceeding from the units place, towards the left, the first period marks units, or integers, the second thousands, the third millions, the fourth billions, and so on. In the same way, preserving the analogy, in the periods descending below units, first occur the parts simply, then thousandths, then millionths, then billionths, and so on; and these last are to be divided into unesimal or unit parts, tenths, hundredths, the others to be collected into units, tens, hundreds.

If then we wish to state the number expressed by any figure of the series, we must, 1st, note the simple value of the figure; 2nd, the value of the place; lastly, of the period. For instance, let the number selected be 9, in the fifth period towards the left. The figure, taken simply, has the value of nine; in consequence of its place, it has the value of nine tens; and in consequence of its period, of nine tens of trillions. Let 5 be chosen in the third period: taken simply, it signifies five; in consequence of its place, five units; in consequence of its period, five units of millions, or five millions. In the second period below unit, let 8 be chosen: the simple value of the figure is eight: in consequence of its place, eight hundredths; in consequence of its period, eight hundredths of thousandths.

If the number to be stated have not words affixed, to denote the value of the periods and of the places, it should be pointed into threes towards the right and left, from the units place, and then should be expressed by the name assigned to the place and period. For instance, let the numbers proposed be 73,480,195. The figures being divided into periods, I first inquire what is the value of the figure in the first place on the the left, which, since it is in the second place of the the third period, is seven tens of millions; but since the numbers advance in tenfold proportion, the value of the first figure being known, the values of the rest

follow in due order. We shall therefore thus express the proposed number: seven tens, and three units of millions; four hundreds, and eight tens of thousands; one hundred, nine tens, and five units: or more concisely, seventy-three millions, four hundred and eighty thousand, a hundred and ninety-five. Hence we perceive that a cypher, though in itself of no value, must of necessity be expressed, for the purpose of assigning a proper place to each figure.

There will be no difficulty in writing and expressing the largest numbers, if due attention be given to what has been just laid down, an acquaintance with which will also afterwards be of the greatest importance; for nature itself teaches us the way of working arithmetical questions on the fingers, but there is need of science to perform these operations accurately, with respect to greater numbers; all turning upon this, that whereas the limited nature of our faculties does not permit the work to be done at once, and with a single effort, we divide it into various operations, by separately inquiring the aggregate or sum, the difference, the product, and then combining them, express the ultimate sum total, remainder, or product; the whole reason and contrivance of the operations resulting from the simple progression of the places, and being ultimately founded on it.

N.B. I am aware that some arithmeticians divide the series otherwise than I do; for compounding the denominations, they use sixes instead of threes. But as others* follow the method pursued by me, I have thought it advisable to retain it as simpler.

CHAP. II.

ON ADDITION.

In addition, the sum of two or more numbers is required; to obtain which the numbers to be added should be set down, so that units should be placed under units, tens under tens, and decimal parts under decimals, and so forth. On this account, when decimal parts are added, the units place should be marked by the insertion of a comma. Then commencing from the right, the figures in the first place should be added, and if any tens result, they should be carried over to the next place, and be added to the sum of the figures of that place, the tens which belong to the next place being reserved, and so the process should be continued. For instance, in the first example of the operations below, 9 and 5 make 14; I therefore reserve the 10 and proceed with the 4; 4 and 8 make 12, therefore I reserve the 10,

* For instance, the celebrated Wallis in his Universal Mathesis, and Father Lamy, in his Elements of Mathematics.

and going on to the next place I find 6, to which I add 2, on account of the tens reserved in the first place; and as 8 and 2 make 10, I reserve that, and set down the 1 which remains, and proceed in the same way.

Addend.	2 0 1 8· 8·2 2·5· 4 3 6 9	523,9702 81,35 60,2005	£ s. d. 7 8 9 3 12 5 0 7 2
Sum	1 4 6 1 2	665,5207	11 8 4

If the things to be summed up be of different kinds, we should proceed in the same way, taking into account, however, the proportions according to which the different denominations advance. For instance, the denominations of pounds, shillings, and pence, do not advance as those of numbers; for 12 pence, not 10 pence, make a shilling; 20 shillings, and not 10 shillings, make a pound. On this account, in adding such quantities, instead of tens, twelves should be carried from the pence, twenties should be carried from the shillings to the next place.

CHAP. III.

ON SUBTRACTION.

In subtraction, the difference of two numbers is required, or what remains after one has been taken from the other; for ascertaining which the less quantity of each denomination should be placed under the greater; then beginning from the right, the first denomination of the quantity to be subtracted is to be taken from that written above it, and the remainder set down below, and the work continued in this way until the whole subtraction be effected.

If, however, it should happen that any number be too small to admit of the lower quantity being taken from it, such upper number should be increased by ten, that is, by a unit borrowed from the next place.

Let it be required to subtract 1189 from 32034; the numbers being set down as in the adjoined example, I set about subtracting the first figure 9 from the 4 placed over it; but as 4 does not even once contain 9, a ten must be added to it, so as to make 14, and then 9 taken from 14 leaves 5. Proceeding then to the left, I have to subtract 8 from 2, not from 3, because we should take into account the ten which has been borrowed, and as

8 cannot be subtracted from 2, I subtract it from 12, and 4 remains. The next figure of the quantity to be subtracted is 1, which, however, cannot be subtracted from nothing or 0; in place of the cipher 0 I use 9; now I use 9, because the ten which is borrowed must be diminished by the unit which has been added to the preceding figure; continuing the process in this manner, 1 taken from 1 leaves nothing. Finally, the subtraction being completed, 3 remain, which I set down below.

In a similar manner, the subtraction of different denominations is effected: only we should observe that ten is not necessarily to be used, but such a number as declares how many of the denomination in question are in the next denomination, and this number should be borrowed to supply the defect of any particular figure.

			£ s. d.
Subtract.	32034 1189	7329,645 3042,100	4 8 3 2 6 5
Rem.	30845	4287,545	2 1 10

N.B. From what has been here laid down, it is plain that the science of arithmetic, as far as we have treated it, consists in doing in detail that which cannot be done at once; and that the reason of reserving tens in addition, and of borrowing them in subtraction, altogether depends on the tenfold advance in the value of the places.

CHAP. IV.

ON MULTIPLICATION.

In multiplication the multiplicand is taken as often as the multiplier requires; or in other words, a number is sought bearing the same ratio to the multiplicand that the multiplier does to unity. That number is called the product, or rectangle; the factors or sides of which are called respectively, the multiplicand, and the number by which it is multiplied.

For finding the product of two numbers, the multiplying number being written under the multiplicand, this last should be multiplied by each figure of the former, beginning from the right hand: the first figure of the product should be written directly under the multiplying figure, and the rest in order towards the left.

The multiplication being finished, the several products should

be collected into one sum, the number of decimal places in which should be equal to those in both the factors.

Let 30,94 be the number to be multiplied by 26,5. Five times 4 produce 20, the first figure of which (0) I place under the multiplying figure (5), and carry the remaining 2; then 5 multiplied into 9 produces 45; 5 with the 2 carried make 7, which I set down, carrying 4 to the next place, and so on.

	30,94 26,5 15470 18564 6188	52886 24 211544 105772	6000 56 36 30
Prod. tot.	819,910	1269264	336000

As there is a twofold value of each number, this should be taken into account, so that the multiplication be rightly effected, that is, that each figure be multiplied as well according to the simple value of the multiplying figure, as according to that which it has from its place. Hence the figure of each respective product is written under the multiplying figure. For instance, in the multiplier of the second example, the figure 2 has the value, not of 2 units, but of 2 tens; therefore, when multiplied into 6, the first figure of the multiplicand, it will produce, not 12 units, but 12 tens; therefore, the first figure of the product should be set down in the place of tens, that is, directly under the multiplying figure 2.

For the same reason, when there are (decimal) parts in the factors, the number produced by the multiplication of the first figure of the multiplier into the first of the multiplicand, is to be removed as far below the multiplied figure as the multiplier is to the right hand below unity; so that as many (decimal) places in the entire product are to be marked off as there were in both factors.

N.B. If there be ciphers continuously to the right of each or of both factors, the multiplication should be performed on the other figures merely, and the ciphers afterwards annexed to the entire product; for since the places advance in value in a tenfold proportion, it is clear that a number becomes tenfold, a hundredfold, a thousandfold itself, if it be advanced one, two, or three places.

CHAP. V.

ON DIVISION.

DIVISION is the reverse of multiplication, its object being to resolve or divide that quantity which the latter produces. The number found by division is called the quotient, because it declares how often the dividend contains the divisor, or, what is the same, the ratio of the dividend to the divisor, or finally, the part of the dividend denominated from the divisor.

In division, having written down the dividend and divisor, as in the first of the subjoined examples, commencing from the left, that part of the dividend containing the divisor, or having the least excess above the containing number, should be marked off by a point. I mean in this instance the simple values. It should then be ascertained how often the divisor is contained in that member of the dividend, and the resulting number will be the first figure of the quotient; the divisor should then be multiplied into the figure thus found, and the product subtracted from the member of the dividend, and the remainder set down below; to which should be annexed the next figure of the dividend, and a new dividend thus obtained, from whence must be ascertained the next figure of the quotient, which being multiplied into the divisor, and the product subtracted from the dividend just divided, the remainder with the next figure of the original dividend annexed will form a new member, and so on, until the operation is finished. The decimal places of the divisor being then subtracted from those in the dividend, the remainder will indicate what number of places should be in the quotient; but if this subtraction be not feasible, so many decimal cyphers should be added to the dividend as are necessary.

If, after the division has been completed, there should be a remainder, by adding decimal cyphers the division can be continued until either nothing remain, or it be so minute that it need not be taken into account, or the remaining figures may be set down and the divisor under them.

If both the dividend and divisor end in cyphers, an equal number of these should be struck off in both: but if the divisor alone end in cyphers they should not be taken into account in the operation, but the same number of the last figures of the dividend should be struck off, and at the end of the work set down, a line drawn below them, and the divisor written underneath.

Let it be required to divide 45832 by 67. Since the divisor is greater than 45 let another figure be added, and the member taken for division be 458, which I separate from the rest of the dividend by a point. 6 is contained in 45 seven times, with three

remainder; but, as 7 is not also contained 7 times in 38, the quotient must be taken less. Let 6 therefore be taken; and, as 6 is contained 6 times in 45 and 9 remains, and 98 contains 7 six times, the first figure of the quotient should be 6. This, multiplied into the divisor, produces a subtrahend 402, which, being taken from 458, there will be a remainder 56; to which I annex 3, the next figure of the dividend, by which means a new dividend is formed 563, which I divide as the former, and find 8 for the second figure of the quotient; and, as 8 multiplied into 67 produces 536, I subtract this from 563, and, adding to the remainder 2, the next figure of the dividend, I obtain 272 as a new dividend, which, when divided, gives 4, which, being first set down in the quotient, and then multiplied into the divisor, and the product subtracted from 272, there remains 4, which should be annexed to the quotient, a line being drawn under it, and the divisor then written below it.

The operation is more speedy when the subtraction immediately follows the multiplication of each figure, and the multiplication proceeds from left to right. For instance, let it be proposed to divide 12199980 by 156, as in the third example; the divisor being written under 1219, the first member of the dividend, it is plain that the one is contained 7 times in the other; and, in consequence, 7 is put down in the quotient. Seven times 1 make 7; which, being subtracted from 12, I strike out both the multiplied figure 1 and 12, the part of the member from which the product was subtracted, setting down above the remainder 5; then I proceed to 5, the next figure of the divisor; 7 multiplied into 5 makes 35, and 35 being subtracted from 51, there remains 16, which I write above and strike out 51 and 5. I then multiply 7 into 6, and the product 42 being subtracted from 69 there remain 27, which I set down, striking out both 69 and 6, the last figure of the dividend. The divisor being now entirely struck out, I set it down, moved one place to the right, and with it I divide the member written above it, which indeed is made up of the remainder of the last divided member increased by the following figure. In this way the divisor should be moved until it goes through the whole dividend.

67)458.32(684$\frac{4}{67}$ 402 ——— 563 536 ——— 272 268 ——— 004	200)8200 2)82(41 8 — 02 2 — 00	41 123 2 567173 12199980(78205 1566666 15555 111

In the next place the reason of the rules will be given; and first, it is plain why we should seek for the quotient by separate divisions.

2ndly, It may, for instance, be asked why, in the example above given, 6 should be taken as the quotient of the first member, divided by the divisor; for 67 is contained in 458 hundreds, not six times but six hundred times, for they are not units but hundreds, since they are distant two places to the left from units.

To this I answer, that in reality not merely 6 but 600 is written in the quotient, for two figures afterwards ascertained follow it, and thus the proper value is assigned to the quotient; for as many places are set down after each figure in the quotient as there are after that member of the dividend from which they are obtained.

3rdly, Since each figure of the quotient indicates how often that member of the dividend from which it was obtained contains the divisor, it is proper that the subtrahend should be formed by multiplying the divisor into the figure last found; for then the divisor is subtracted exactly as often as it is contained in the dividend, unless it should happen that the number last set down in the quotient should be too large or too small: if the first be the case the product will be so large that it cannot be subtracted; if the latter be the case, then the resulting product will be so small, that after performing the subtraction the remainder will be equal to or greater than the divisor.

4thly, The reason why so many (decimal) places should be marked off in the quotient that with those which are in the divisor they may be equal to those in the dividend, is that the dividend is the product resulting from the multiplication of the divisor into the quotient, and consequently it should have as many decimal places as those two, as we have shown when treating of multiplication.

5thly, It is clear that decimal cyphers, annexed to the end of the dividend, do not affect its value; for as to the integers, those which are removed for the same distance from the units' place, have the same value, but decimals are not diminished in value unless the cyphers be placed before them.

6thly, Since the quotient expresses or denominates the ratio of the dividend to the divisor, it is clear, that as long as that continues the same the quotient must be the same; but the common cyphers, being cast away, the ratio of the numbers to each other is not in the slightest degree altered. Thus, for instance, 200 bears the same ratio to 100—that is, 200 contains 100 as often as 2 contains 1, which is sufficiently manifest by itself.

CHAP. VI.

ON FORMING SQUARES AND FINDING THEIR ROOTS.

THE product of a number multiplied into itself is called its square; and the number by the multiplication of which into itself the square is produced is called the square root or side; and the operation by which we search for the root of the given square is called the extraction of the square root; for understanding which it will be necessary to consider the manner in which the square is produced, the parts of which it is composed, their order, and relative position. And since it is best in acquiring a knowledge of any thing to proceed from the simplest and easiest, let us commence with the consideration of the production of a square, resulting from a binomial root.

We should, in the first place, closely consider what takes place when a number, consisting of two figures, is multiplied into itself. And first it is plain that the first figure on the right of the root is multiplied into the one placed above it, that is, into itself, and thence results the square of the lesser number. Then, by multiplying the same figure into the next part of the multiplicand, a rectangle results contained by both members of the root. Having then finished the multiplication of the whole multiplicand by the first figure of the root, we come to the second, which, being multiplied into the first figure of the multiplicand, there results again a rectangle, contained under the two figures of the binomial root; then the second figure of the multiplicand multiplied into itself, gives the square of the second member of the binomial root. We ascertain from this that any square produced from a binomial root consists, in the first place, of the square of the lesser member; in the second, of double the rectangle contained under the members; in the third, of the square of the greater member.

Let it be required to square a binomial root, for instance, 23, according to what has been laid down in Chap. IV. I first multiply 3 into 3, which gives 9, as the square of the first member; I secondly multiply 3 into 2, the other figure of the root, and obtain 6, the rectangle contained by both; thirdly, from 2 multiplied into 3 arises a second time, the rectangle contained under the members; in the fourth place, 2 multiplied into 2 produces 4 the square of the greater member.

23	
23	
69	
46	

Let us now proceed to the production of a square, from a root

of three members. In this operation, the first figure of the root multiplied into the whole root, produces, in the first place, the square of the first member; in the second place, the rectangle contained under the first and second member; in the third place, the rectangle contained under the first and third member. Now for the second figure, this multiplied into the root gives first the rectangle contained under the first and second member; secondly, the square of the second member; thirdly, the rectangle contained under the second and third members. Lastly, from the third figure of the root, multiplied into the root, results first, the rectangle contained under the first and third members; secondly, the rectangle contained under the second and third members; and thirdly, the square of the third member.

From this we ascertain, that a square, produced from a trinomial root comprises, first, the square of the first figure of the root; secondly, double the rectangle contained under the first figure and the two others; in the third place, the square of the two others, that is, the square of each, and also double the rectangle contained under both, which we have before shown, constitute the square of the two figures.

In the same way, it can be shown, that the square of four, five, or any number of figures, contains, first, the square of the figure of lowest value; secondly, double the rectangle resulting from the multiplication of the figure of lowest value into all the others; thirdly, the square of all the other figures, which itself, as is plain from what has been stated, contains the square of the figure next from the right, double the rectangle of that same figure multiplied into all the others, the square of all the other figures, which in the same way contains the square of the third figure, two rectangles of it, and the others, and the square of these, and so on, until we come to the square of the highest figure of the root.

The parts of which the square is composed being ascertained, we should next consider, concerning their arrangement and place. If therefore, beginning from the right, we divide the square into periods of twos, from the mode of production which we have explained above, it is plain that the first member from the left will be occupied by the square of the first or highest figure, and at the same time, of that portion of double the rectangle resulting from the multiplication together of the first and second figures, which is redundant above the first place of the following period of two; that the first place of the second period contains double the rectangle mentioned, and besides whatever of the square of the second figure is over; that the second contains the square of the second figure, and whatever is over of double the rectangle of the two first figures, multiplied into the third as far as the lowest figure at the first place of the third two, and so on.

For instance, in the annexed example, the first member 10 contains 9, the square of the first figure 3, besides 1 by which 12 (double the rectangle of the figure 3 multiplied into the following 2) exceeds the first place of the second member. The first place of the second two contains 2 (the remainder of the double rectangle of the figures 3 and 2), and also that which is over the next following place, and so on, &c.

321
321
321
642
963
10.30.41

Having thus considered the formation of the square, let us proceed to its analysis. Let any number, for instance 10.30.41, be proposed, the square root of which is required. This should be pointed off by twos, beginning from the right in case the number be even, as if otherwise the last member will consist of but one figure. I then inquire, what is the greatest square contained in 10, the first member towards the left, and 3, the root of this, is the first figure of the root required, the square of which (9) I subtract from (10) the member. From the remainder (1), with (3) the first figure of the following member added, is formed a dividend (13), which I divide by the found figure doubled (6), the quotient (2) will be the second figure of the root; which being multiplied first into the divisor, and then into itself, and the sum of the product, taken so, however, that the latter be removed one place to the right (124), I take away this from the dividend (13), increased by 0, the remaining figure of the second member. To the remainder 6, I add 4, the first figure of the third two, and so a new dividend (64) is produced, which being divided by 64, twice the root already found, gives 1, the third of the required root; this being then multiplied into itself and the products added up, I subtract the sum (641) from the dividend, increased by the addition of the other figure of the third member, and in this way we must proceed to whatever length the operation may be carried.

If after the last subtraction there be a remainder, it shows that the given number was not a square; however by adding to it decimal cyphers, the operation can be continued to any extent thought desirable.

If there be any decimal places in the number, for the root of which we are searching, their number divided by two, will show how many should be in the root. The reason of this appears from Chap. IV.

The reason of the mode of proceeding is quite clear from what has been stated. For as a divisor I employed 6, the double of the found figure, because, from the formation of the square as it has been explained, I knew that double the rectangle of that figure, multiplied into the following one, comprised the dividend; consequently, if this were divided by the double of one factor (3), that the other factor (2), that is, the next figure

of the root, could be obtained. So likewise I have formed a subtrahend from double the rectangle of the quotient and divisor, and the square of the quotient added together, because I found that those two rectangles and the square were contained in that order in the remainder and the following member from which the subtraction was made, and so the evolution of the power is easily effected from its involution or formation.

CHAP. VII.

CONCERNING THE INVOLUTION AND EVOLUTION OF THE CUBE.

THE root multiplied into the square produces the cube. To prepare the way for the analysis we should, as has been done in the former chapter, begin with the composition of the power. In the production then of the cube from a binomial root, the first member of the root, in the first place, meets with its own square, whence results the cube of the first figure; secondly, double the rectangle of the members, whence double the solid of the square of the first figure multiplied into the other; thirdly, the square of the other member, whence the solid produced from the first figure and the square of the second. In the same way, when the multiplication takes place by the second member, there arises the solid of the second figure and of the square of the first; in the second place double the solid of the first figure and of the square of the second; in the third place the cube of the second member.

Therefore the cube produced from the binomial root contains the cubes of the two members and six solids, that is to say, three made from the square of each member, multiplied into the other.

The reasoning being continued according to the analogy of the preceding chapter, it will follow, that if, as the square should be divided into twos, the cube resulting from any root be distributed into threes, that the three, or member first from the left, contains the cube of the figure first on the left, and also the excess, if there be any, of three solids of the square of the same, multiplied into the second; that the first place of the second contains the said solids and the excess of the three solids of the square of the second figure, multiplied into the first; that the second place contains the same three solids and the excess of the cube of the second figure; and that the third is occupied by the said cube and the excess of the three solids produced from the square of the preceding figures, multiplied into the third; and that the solids just mentioned fill the first place of the third member, and so on. From this we shall easily derive the following manner of extracting the cube root.

Beginning from the right, I divide, by means of points, the resolvend (80621568) into threes, except the last member, which can be less. I then take the greatest cube (64) contained in the first member towards the left, and having written down its root (4) for the first figure of the sought root, I annex to the remainder (16) the next figure (6) of the resolvend, whence results a dividend (166), which I divide by 48, thrice the square of the figure which has been found: the quotient (3) is the second figure of the root. I multiply this first into the divisor, secondly its square into three times the first figure, and thirdly itself into itself twice. The products then being collected in this way, that the second be set down one place to the right of the first, the third one place to the right of the second. $\left\{\begin{array}{r}144\\108\\27\end{array}\right\}$ I subtract it from the dividend increased by the addition of the two remaining figures of the second member. In this way, however prolonged the operation, a dividend will always result from the remainder, with the addition of the first figure of the following member, and a divisor from three times the square of the figures of the root already found, and a subducend from the figure last found, the square of the same multiplied into three times the preceding figures, lastly its cube, and these collected in the manner set forth.

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   80.621.568(432
   64
   ------
48)16621
   15507
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5547)1114568
     1114568
     -------
     0000000
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If the resolvend be not a cube, by adding decimals to the remainder you can carry its exhaustion to infinity.

The root should have a third part of the decimal places of the resolvend.

N. B. Synthetical operations can be examined by means of analytical, and analytical by means of synthetical; so if either number, being subtracted from the sums of two numbers, the other remains, the addition has been rightly performed; and *vice versâ*, subtraction is proved to be right when the sum of the subtrahend and remainder is equal to the greater number. So if the quotient multiplied into the divisor produce the dividend, or the root multiplied into itself produce the resolvend, it is a proof that the division or evolution has been correct.

ARITHMETIC.

PART II.

CHAP. I.

ON FRACTIONS.

It has been before mentioned that division is signified by setting down the dividend with the divisor under it, and separated from it by a line drawn between them. Quotients of this kind are called broken numbers, or fractions, because the upper number, called also the numerator, is divided or broken into parts, the denomination of which is fixed by the lower, which is therefore called the denominator. For instance in the fraction $\frac{2}{4}$, 2 is the dividend or numerator, 4 the divisor or denominator, and the fraction indicates the quotient which arises from 2 divided by 4, that is the fourth of any two things whatever, or two fourths of one, for they mean the same.

N. B. It is clear that numbers which denote decimal parts, and which are commonly called decimal fractions, can be expressed as vulgar fractions, if the denominator be written beneath. For instance, .25 is equivalent to $\frac{25}{100}$, .004 is equivalent to $\frac{4}{1000}$, &c., which we must either do, or understand to be done, as often as those are to be reduced to vulgar fractions, or conversely these are to be reduced into those, or any other operation is to take place equally affecting both fractions, decimal and vulgar.

CHAP. II.

OF ADDITION AND SUBTRACTION OF FRACTIONS.

1. If fractions, whose sum or difference is sought, have the same denominator, the sum or difference of the numerators should be taken, and the common denominator written under, and this will be the answer.

2. If they be not of the same denomination let them be reduced to the same denomination. The denominators multiplied into each other will give a new denominator, but the numerator of each fraction multiplied into the denominators of the others will give a numerator of a new fraction of equal value. Then the new fractions should be treated as above.

3. If an integer is to be added to a fraction or subtracted from it, or *vice versâ*, it should be reduced to a fraction of the same denomination as the given one; that is, it is to be multiplied into the given denominator, and that denominator to be placed under it.

Addition.	$\frac{1}{3}$ to $\frac{2}{3}$ sum $\frac{3}{3}$	
Subtraction.	$\frac{1}{3}$ from $\frac{3}{3}$ rem. $\frac{2}{3}$	
Addition.	$\frac{5}{6}$ to $\frac{3}{4}$, that is $\frac{8}{12}$ to $\frac{9}{12}$, sum $\frac{17}{12}$	
Subtraction.	$\frac{2}{3}$ from $\frac{3}{4}$, that is $\frac{8}{12}$ from $\frac{9}{12}$, rem. $\frac{1}{12}$	
Addition.	3 to $\frac{1}{8}$, that is $\frac{24}{8}$ to $\frac{1}{8}$, sum $\frac{25}{8}$	
Subtraction.	$\frac{1}{8}$ from 3, that is $\frac{24}{8}$, rem. $\frac{23}{8}$	

In the first place, it should be explained why fractions should be reduced to the same denomination before we treat them; and it is on this account, that numbers enumerating heterogeneous things cannot be added together, or subtracted from each other. For instance, if I wish to add three pence to two shillings, the sum will not be 5 shillings, or 5 pence, nor can it be ascertained before that the things mentioned be brought to the same sort, by using 24 pence instead of 2 shillings, to which if I add 3 pence, there results a sum of 27 pence; for the same reason, if I have to add 2 thirds and 3 fourths, I do not write down 5 parts either thirds or fourths, but, instead of them I employ 8 twelfths and 9 twelfths, the sum of which is 17 twelfths.

Secondly. I wish to show that fractions after such reduction are of the same value as before, for instance, $\frac{2}{3}$ and $\frac{6}{12}$; since both numerator and denominator are multiplied by the same number (4); but every fraction represents the ratio of the numerator or dividend to the denominator, or divisor, and consequently as long as that remains the same, the fraction retains the same value, but each term of the ratio being multiplied by the same number, it is certain that the ratio is not changed: for instance, if the half of one thing be double the half of another, that whole will be double this whole, which is so plain that it does not require proof.

Thirdly. An integer reduced to a fraction is not altered in value, for if the rectangle of two numbers be divided by one of them, the other will be quotient; but, in the reduction of an integer to a fraction, it is multiplied into the given denominator, and also divided by it, therefore the fraction has the same value as the given integer.

N. B. It will sometimes be useful to reduce a fraction to a given

denominator, for instance, $\frac{2}{3}$ to another whose denominator is 9, which is done by means of the rule of three (laid down subsequently), by finding a number to which the given denominator will be as the denominator of the given fraction to its numerator; that will be the numerator of the fraction of which the name has been given, and the value will be the same as of the former, for, in each instance the ratio between the terms of the fraction is the same.

CHAP. III.

OF THE MULTIPLICATION OF FRACTIONS.

1. If a fraction is to be multiplied into a fraction, the numerators of the given fractions multiplied into each other will give the numerator of the product, and the denominators in the same way will give the denominators.

2. If a fraction is to be multiplied into an integer, the given integer should be multiplied into the numerator of the fraction, the denominator remaining the same.

3. If in either factor, or in both, integers occur, or heterogeneous fractions, they, for the sake of clearness, should be collected together.

Examples of Multiplication.

Multiply	$\frac{3}{4}$ by $\frac{5}{6}$, prod. $\frac{15}{24}$, $\frac{4}{7}$ by 2, prod. $\frac{8}{7}$.
Multiply	2 and $\frac{3}{4}$ by $\frac{1}{2}$ and $\frac{3}{5}$, that is, $\frac{11}{4}$ by $\frac{7}{5}$.

1. It is plain that the quotient is increased in the same proportion as is the dividend: for instance, if 2 be contained three times in 6 it will be contained twice three times in twice 6. It is plain also that it is diminished in the same proportion as the divisor increases: for instance, if the number 3 be contained 4 times in 12, twice 3 will be contained only twice in 12; therefore when I multiply $\frac{2}{3}$ by $\frac{5}{6}$, the fraction $\frac{2}{3}$ is to be increased in a fivefold ratio, since it is to be multiplied by 5; and to be diminished in an eightfold ratio, since it is multiplied, not actually by 5, but only by its eighth part; consequently I multiply the dividend 2 by 5, and the divisor 3 by 8.

2. As to the second rule, it is plain that twice 4 of any things are equal to 8 things of the same denomination, whatever it may be.

CHAP. IV.

ON DIVISION OF FRACTIONS.

1. A FRACTION is divided by an integer, by multiplying the given integer into the denominator of the given fraction.

2. If a fraction is to be divided by a fraction, the numerator of the divisor multiplied into the denominator of the dividend will give the denominator of the quotient; and its denominator multiplied into the numerator of the dividend will give the numerator of the quotient.

3. Whenever integers or fractions of different denominations are mixed, the easiest way of proceeding will be to collect the members of each, as well dividend as divisor, into two sums.

Examples of Division.

Divide $\frac{3}{4}$ by 2, quot. $\frac{3}{8}$.
Divide $\frac{3}{4}$ by $\frac{2}{3}$, quot. $\frac{9}{8}$.
Divide $2\frac{1}{4}\frac{3}{4}$ by $3\frac{3}{4}$, that is, $\frac{9}{4}$ by $\frac{15}{4}$.

1. As to the first rule, it is clear from the preceding chapter that a fraction is lessened or divided in the same proportion as the denominator is multiplied.

2. Since to divide one fraction by another, for instance $\frac{4}{5}$ by $\frac{2}{3}$, I have multiplied the denominator 9 into 2, the fraction $\frac{4}{18}$ only expresses how often 2 is contained in the dividend; but the fifth of it will indicate how often the fifth part of the number 2 is contained in it; wherefore I multiply the first quotient $\frac{4}{18}$ by 5, whence results $\frac{20}{18}$.

N.B. If the given fractions be homogeneous, the shorter and more elegant way is to divide the numerator of the dividend by the numerator of the divisor as often as it measures it. Thus, $\frac{6}{8}$ being divided by $\frac{3}{8}$, the quotient will be 2, for whatever things are enumerated by 6 contain 3 twice.

2. If a root is to be extracted from a given fraction, the root of the denominator, placed under the root of the numerator, will form a fraction, which is the root sought. For instance $\frac{3}{7}$ is the square root of the fraction $\frac{9}{49}$, and the cube root of the fraction $\frac{8}{343}$; for, from what we have said about multiplication it is clear that $\frac{3}{7}$ multiplied into $\frac{3}{7}$ produces $\frac{9}{49}$; and that $\frac{3}{7}$, multiplied into $\frac{9}{49}$, produces $\frac{27}{343}$.

CHAP. V.

OF THE REDUCTION OF FRACTIONS TO THEIR LOWEST TERMS.

1. SINCE the value of fractions is most easily ascertained when they are at their lowest terms, it is of advantage when feasible to divide fractions by a common measure. The greater that common divisor may be so much less will be the quotients or terms of the fraction equal to the given one. It is necessary, therefore, when two numbers are given, to have a method of finding their greatest common measure, that is to say, the greatest divisor which will divide the given divisor without a remainder. Such is the following:

2. Divide the greater of the given numbers by the less, and that divisor by the remainder of the division; and, if still there be a remainder, you should by it divide the former divisor—that is, the last remainder, and so on until you come to a divisor which exhausts or measures its dividend, that is, the greatest common measure of the two.

For instance, let 9 and 15 be the given numbers. I divide 15 by 9, and 6 remains; I divide 9 by 6 and 3 remains; I divide 6 by 3 and nothing remains. Therefore 3 is the greatest common measure of the two numbers 9 and 15, which I show thus.

(*a*) 3 measures 6, but (*b*) 6 measures 9, if 3 be taken away. Therefore 3 measures 9, if 3 be taken away; but 3 measures itself, therefore it measures the whole 9; but (*c*) 9 measures 15, 6 being taken away; therefore 3 measures 15, 6 being taken away; but it measures 6, therefore it measures the whole number 15. Hence it is clear, that 3 is the common measure of the given numbers, 9 and 15. It remains for me to show, that it is the greatest common measure. If not, let there be some other common measure, say 5. Now since (*e*) 5 measures 9, (*d*) but 9 measures 15, 6 being taken away; it is plain that 5 measures 15, 6 being taken away; but it measures the whole 15 (by hypothesis), therefore it measures 6; but 6 measures 9, 3 being taken from it; therefore 5 measures 9, 3 being taken from it. Therefore since 5 measures both the whole of 9, and 9, 3 being taken from it: it will also measure 3 itself, that is, (*f*) the lesser number, which is absurd.

The greatest common measure being found, it is plain that the fraction $\frac{9}{15}$ can be lowered to this fraction $\frac{3}{5}$, which I thus show to be equal to the former. Every fraction denotes the quotient of the numerator divided by the denominator; but in division the quotient expresses the ratio of the dividend to the divisor; whilst the ratio therefore remains the same, the quotient or frac-

(*a*) By construction. (*b*) By construction. (*c*) By construction. (*d*) By construction. (*e*) By hyp. (*f*) By hyp.

tion will be the same. Moreover, it is very clear, that the ratio is not changed, its terms being equally divided; for instance, if any thing be double of another, or triple, the half of that will be double or triple of the half of the other.

Those who can divide and multiply fractions by integers will find no difficulty in reducing fractions of fractions to integers. For instance, this fraction of a fraction $\frac{2}{4}$ of $\frac{3}{5}$, what else is it, than three times the fourth part of the fraction $\frac{3}{5}$, or $\frac{3}{20}$ mutiplied into the integer 3? In like manner, the numerators and denominators being mutually multiplied into the fraction of a fraction of a fraction, is reduced to an integer. Since these things are so clear and manifest, it is amazing by what circuitous processes, what a tedious apparatus of theorems, quotations, and species they are demonstrated, or rather obscured.

ARITHMETIC.

PART III.

CHAP. I.

OF THE RULE OF PROPORTION.

THE rule of Proportion is that by which, three numbers being given, a fourth, proportional to them, is found. Its use is frequent and very great, and hence it is called the golden rule. It is also called the Rule of Three, on account of the three given terms. We directly find the fourth proportional by multiplying the second term by the third, and dividing the product by the first; for instance, if as 2 is to 6, so should 4 be to the number required; multiply 4 into 6, and divide the product 24 by 2, the quotient 12 will be the fourth proportional required, which I demonstrate as follows.

In four proportionals the product of the extremes is equal to the product of the intermediate terms. For, since the numbers are proportional, that is, have the same ratio between themselves, but ratio is estimated by division, if the second term be divided by the first, and the fourth by the third, the quotient will be the same, which, according to the nature of division, multiplied into the first term will produce the second, and into the third will produce the fourth. If therefore we multiply the first term into

the fourth, or which is the same thing, into the third and common quotient, and the third term into the second, or which is the same thing, into the first and common quotient, it is clear that the products will be equal, as the factors are in each case the same. But from the nature of multiplication and division, it is clear that the product being divided by one of the factors, the other is the quotient; therefore if I divide the product of the two intermediate terms (6 and 4) by the first (2), the quotient (12) will be the fourth proportional sought.

Question 1. A traveller in 3 hours goes 15 miles: how many will he go in 9 hours? Answer 45. For it is clear from the question, that as 3 is to 15, so is 9 to the number required; that is, 3 : 15 : : 9 : therefore 135, the product of 9 into 15, divided by 3, will give the number required, that is 45.

Question 2. If 2 workmen in 4 days earn 2s., how much will 5 earn in 7 days? that is, as 2 multiplied by 4 are to 2, so are 5 multiplied by 7 to the number sought; or as 8 : 2 : : 35 to the number sought; and thus the hire sought is found to be 8s. 9d.

Question 3. Three merchants forming a partnership, gain £100. The first spent £5, the second £8, the third £10. It is sought how much each gained. The sum of the expenditure is £23. Say therefore, as 23 is to 5, so is £100 to the sum sought. The resulting number will indicate how much is due to the first from the common gain, for it is fair that, as the expense of each is to the sum of the expenses, so should be his gain to the sum of the gains. Further, in the same way by saying 23 : 8 : : 100 &c., and 23 : 10 : : 100, &c., the gains of the others will appear.

The inverse rule of proportion is easily resolved into simple. For instance, 2 men expend £5 in 6 days: in how many days will 8 men expend £30? Say first 2 : 5 : : 8 : &c. and the answer will be 20; say therefore, then as 20 : 6 : : 30: &c. and you will find the number required. It is superfluous to explain, why the sought term immediately is found by means of this rather intricate rule.

4th Question. Four pipes fill a cistern in 12 hours: in how many hours will it be filled by 8 of the same size? We should say, as 8 : 4 : : 12 : &c.; then 4, multiplied into 12, that is, 48 divided by 8, give the answer, that is 6. Nor in this case, when the proportion is inverted, is there any new difficulty; for the terms being properly arranged, we shall have two equal rectangles of one, of which both sides are known, but the other is produced from the known term, multiplied into the unknown; and by dividing that first product by the known side or factor, the unknown term will come out. But it will appear from the question itself, in what order the terms are to be arranged.

CHAP. II.

ON ALLIGATION.

THE rule called Simple Alligation is that by which, two things being given, of different price or weight, &c., there is found some third sort, so compounded of the given, that its price, weight, &c., be equal to a given price, weight, &c., intermediate between the given. For instance, a cubic inch of gold weighs 18 ounces, a cubic inch of silver weighs 12 ounces. It is required to have a cubic inch of metal compounded of both, and weighing 16 ounces: in which problem, the intermediate weight 16, exceeds the weight of silver by 2, and is exceeded by the weight of gold, by 2. Now if we take $\frac{2}{6}$ of a cube inch of silver and $\frac{4}{6}$ of a cube of gold, it is clear that these, if combined, will make up a cube inch, as they are equal to unity. But it is also plain, that the weight of this mixed metal is equal to the intermediate 16; for we took 2 parts of silver, which is lighter by 4, therefore the defect is 2 in 4; but of gold, which is heavier by 2, we took 4 parts, so the excess is 4 in 2; that is, equal to the defect, so that they counterbalance each other.

Hence results a rule for the alligation of two things. The quantity of the greater, which is to be taken, is indicated by a fraction, the denominator of which is the sum of the differences, and the numerator, the difference between the middle and less; and in the next place, that which has the same denominator, and for numerator the difference between the greater and middle, shows the less quantity which is to be taken.

Question. There are two kinds of silver: the ounce of finer is worth 7 that of inferior quality is worth 4; we want to find 3 ounces of silver which are each worth 5. Answer. It is clear, that if I take $\frac{2}{3}$ of the inferior, and $\frac{1}{3}$ of the finer, there will be one ounce of the mixed compound, and three times this will be the quantity required.

If the things to be alligated are more than two, the rule is called Compound Alligation. For instance, there are five kinds of wine, the strength of massic is 1, of chian 3, of falernian 5, of cæcuban 7, of corcyræan 9: I require a mixture, the strength of which is 4. The strength of a mixture of equal parts of massic and chian, will be 2, being half of the sum of that of the given quantities 1 and 3, as is plain; so the strength of a mixture of equal parts of falernian, cæcuban, and corcyræan will be 7; that is $\frac{1}{3}$ of the number 21, or of the sum of the strengths of the com-

ponents of the mixture. I alligate 2 and 7 with the given intermediate strength 4, and the defect is 2, the excess 3, the sum of the differences 5; consequently there should be taken $\frac{3}{5}$ of the first mixture, $\frac{2}{5}$ of the latter, then $\frac{2}{5}$ being divided by 2, the quotient shows how much of each, chian and massic, should be taken. In the same way $\frac{1}{5}$ divided by 3, will indicate how much of falernian, &c., should be in the required mixture. So $\frac{3}{15}$ massic, $\frac{3}{15}$ chian, $\frac{2}{15}$ falernian, $\frac{2}{15}$ cæcuban, $\frac{2}{15}$ corcyræan, will give the answer.

Hence we perceive how compound alligation may be reduced to simple. The prices, magnitudes, weights, or whatever else should be alligated, ought to be collected into two sums, which are to be divided each by the number of terms which constitute it; the quotients should be alligated with the intermediate term; the resulting fractions, divided each by the number of things entering into the sum to which they refer, will express the quantity of each to be taken. The demonstration is plain, from what has been said.

N.B. In alligation of several things, each question admits of innumerable solutions, and this for two reasons; first, the deficient terms can be combined with the exceeding ones in several ways, whence will result various quotients to be alligated with the given intermediate term. Care should be taken, however, lest the quotients be together greater, or together less, than the mean; for if this happen, it is plain that the question is impossible; secondly, it is allowable frequently to repeat the same term, whence its share or portion will be increased, but those of the others diminished.

I am glad here, for the gratification of the studious, to give a solution of that famous problem given to Archimedes by Hiero.

Question: A crown is made of an alloy of gold and silver: it is asked how much gold, how much silver, is in it, and the king does not allow the crown to be broken up. Ans. Two masses should be taken, one of gold, another of silver, each of equal weight with the crown, which being done, it is manifest that the problem could be proposed in another form, as follows: a pound of gold and a pound of silver being given to find a pound of an alloy made up of both, which shall be of the given intermediate mass. Now, as the solid contents of the crown cannot be ascertained geometrically, there is need of contrivance. Each of the masses should be separately immersed in a vessel full of water, and the quantity of water which flows out on each immersion should be measured, it being obvious that it must be equal in bulk to the immersed mass; suppose the gold being immersed, let the bulk of displaced water be 5, of the silver 9, of the crown 6. The question, therefore, comes to this; there being given a pound of gold of the magnitude of 5, and a pound of silver of the

magnitude of 9, it is required how much of each we should take to have a pound of an alloy of the magnitude of 6. Then if 9 and 5 be alligated with the intermediate magnitude 6, the quantity of gold will be ascertained, that is, $\frac{3}{4}$ of the quantity of gold, and $\frac{1}{4}$ of the quantity of silver, combined in the crown.

Hence it appears how little difficulty there is in the problem on the solution of which Archimedes of old exclaimed Εὑρηκα.

CHAP. III.

OF ARITHMETICAL AND GEOMETRICAL PROGRESSION.

ARITHMETICAL progression is a name given to a series of numbers increasing or diminishing by a common difference. For instance, in this series 1, 4, 7, 10, 13, 16, 19, 22, 25, 3 is the common excess by which the second term exceeds the first, the third the second, the fourth the third, and so on; and in this other series of decreasing numbers 15, 13, 11, 9, 7, 5, 3, 1, 2 is the common quantity by which each number falls short of the preceding.

Now, from considering this series and the definition which we have laid down, it is manifest that each term contains the lesser extreme, and the common difference multiplied by the number of places by which it is removed from that lesser extreme. For instance, in the first series the number 13 consists of the lesser extreme 1, and the common difference 3 multiplied into 4, the number of places by which it is removed from the lesser extreme. Hence the lesser extreme and the common difference being given, any term, for example the eleventh from the lesser exclusive, can be easily found, by multiplying the difference 3 into 11, and adding the product 33 to the lesser extreme 1. If the greater extreme, the common difference, and the number of places intervening between the term sought and the greater extreme be given, the term sought may be found by multiplying the difference into the number of places, and taking the product from the greater extreme. It is clear also how the first term is assigned, if any term, its index, and common difference be given; and how the common difference may be obtained if any term, its index, and the lesser extreme be given; and also how the index of any term may be obtained if the term, the difference, and lesser extreme, be given. It is also clear that the half of the sum of two terms is equal to the arithmetical mean proportional. For instance, 7 and 13 make 20, whose half, 10, is a mean between the given terms. Any one can easily deduce these and many other

problems and theorems, and their solutions, from the nature of arithmetical progression, especially if he use skilful symbolical computation. I therefore leave them to beginners for points of practice.

GEOMETRICAL progression is the name given to a series of numbers increasing or decreasing by the same continued ratio. For instance 3, 6, 12, 24, 48, 96 are in a geometrical progression, the common ratio of which is twice, as each term is twice the preceding one. In like manner the numbers of this decreasing series 81, 27, 9, 3, 1, proceed in a subtriple ratio, that is, each term is in a subtriple ratio to the preceding, or $\frac{1}{3}$; where it should be observed that each term is composed of the power of the common ratio, bearing the same name with it, multiplied into the first term. For instance, 48, the fourth term, exclusively, is produced from 16, the fourth power of the number 2 (that is, that which produced from 2 multiplied three times into itself, since the root itself is called the first power,) multiplied by the first term 3. Wherefore what has been laid down concerning arithmetical progression holds good here, if, instead of addition and subtraction, we use multiplication and division; and instead of multiplication and division, involution and evolution, or the extraction of roots.* For instance, as in arithmetical progression the sum of the extremes divided into two equal parts gives the arithmetical mean, so in geometrical progression the mean proportional is the root of the product of the extremes. Therefore, as regards theorems and problems, we shall not longer dwell upon deducing them, since they easily result from the mere consideration of the series.

But there is one theorem of geometrical progression from which the knowledge of logarithms was originally derived, and on which they still rest; and which therefore it is fit to explain here. In a geometrical progression, the commencement of which is unity, the rectangle of any two terms is equal to the term of the same progression, which has for index the sum of the index of the factors. For instance, if in the following series, $\begin{cases} 1, 2, 4, 8, 16, 32, 64, \\ 0, 1, 2, 3, 4, 5, 6, \end{cases}$ the second term 2 be multiplied into the fourth 8, the product, 16, is the fifth term, the index of which, 4, is the sum of the indexes of the second and fourth. The reason is manifest; for each power, multiplied into any other power of the same root, produces a third, in which there are as many dimensions as there were in both of the generating powers. But in a geometrical progression, of which the first term is unity, it is clear that all the other subsequent ones are powers produced from the common

* N.B. A careful reader can investigate how the roots of any powers may be extracted by means of the method which we followed when treating of the cube, the square, and their roots.

ratio, and that each have as many dimensions as their places are distant from unity. Therefore, if to an infinite geometrical progression there were annexed also an infinite series of indices, to obtain the rectangle of two terms it would not be necessary to multiply one by the other; but, merely adding the indices to find an index equal to the sum, and this would show the sought rectangle annexed to it. In like manner, if one term is to be divided by another, the difference of the indices, if the square or cube root is to be extracted, $\frac{1}{2}$ or $\frac{1}{3}$ as an index, would show the required quotient or root.

Hence it is plain that the more difficult operations in arithmetic could be singularly abridged, if tables were formed in which the numbers placed in natural order should have each a corresponding index annexed; for then multiplication can be effected by addition alone; division by subtraction; the extraction of roots by halving or trisecting the indices: but to accommodate those indices or logarithms to numbers, "this is the task, this the labour," in effecting which numbers of mathematicians have toiled.

The first who formed tables generally proceeded in this way. To the numbers 1, 10, 100, 1000, &c., in decuple progression, they assigned the logarithms 0,0000000, 1,0000000, 2,0000000, 3,0000000, &c. Then to find the logarithm of any number, for instance, 4, between 1 and 10, seven cyphers being added to each, they sought a mean proportional between 1,0000000 and 10,0000000; and if it were less than 4, the mean proportional was to be sought between it and 10,0000000, but if greater, between it and 1,0000000; and then they finally sought a mean proportional between this (if it were less than 4) and the next greatest, but if greater, and the next less, and so on until they came to a number differing by a very small part, for instance $\frac{1}{10000000}$, from the proposed 4. Then the logarithm of this was had by finding an arithmetic mean between the logarithms of the numbers 1 and 10, and another between it and the logarithm of ten, &c. Now if the logarithm of the number 4 be halved, the logarithm of 2 is found; the same when doubled gives the logarithm of the number 16; and if to the logarithm of 4 be added the logarithm of 2, the sum will be the logarithm of 8.

In the same way, from one logarithm of the number 4, others innumerable can be obtained. In this manner, when logarithms were adapted to other numbers between 10 and unity, they supplied very many others to their sum and difference. But of this enough; for we have not undertaken to give all things which bear on logarithms. It was merely proposed to a certain extent to explain their nature, use, and invention.

MATHEMATICAL MISCELLANIES:

SOME THOUGHTS

CONCERNING

SURD ROOTS, THE ATMOSPHERIC TIDE, AN EQUILATERAL CONE AND CYLINDER, CIRCUMSCRIBED ABOUT THE SAME SPHERE, ON THE ALGEBRAIC GAME,

AND SOME PERSUASIVES TO

THE STUDY OF MATHEMATICS, ESPECIALLY ALGEBRA.

BY * * * * BACHELOR OF ARTS,

TRINITY COLLEGE, DUBLIN.

TO THAT EXCELLENT YOUTH,

D. SAMUEL MOLYNEUX,

FELLOW COMMONER IN DUBLIN COLLEGE, SON OF THE EMINENT WILLIAM MOLYNEUX, CUT OFF A FEW YEARS AGO, BY A FATE LAMENTABLE BOTH FOR HIS COUNTRY AND THE INTERESTS OF LITERATURE.

EXCELLENT YOUTH,

Such was the esteem in which your father when living was held by the learned, that I consider I would do them a grateful service, if I should show that he has left a son, who inherits his penetration and sagacity. It must indeed be allowed, that your uncle,* a man of a remarkably enlarged and well-informed mind, had previously done something of the kind. For that eminent man had perceived your disposition as you approached maturity, that it was probable you would follow in the footprints of your father. The authority of such a man influenced me so far, that I from that thenceforth conceived great hopes of you. But now when becoming acquainted with the nature of your studies, I perceive you devoting yourself to sound philosophy and mathematics, when I perceive that the thorns which seem to beset mathematics, and usually deter others from its study, on the contrary, spur you on to a more speedy progress; when I also see, that high intellectual powers accompany that industry and desire of knowledge, I cannot restrain my joy from manifesting itself to the learned world, and expressing my undoubting anticipation that, if God grant you life and health, you will be one of the chief ornaments of the rising age. Wherefore, presenting to you the following pieces, whatever may be their merit, I wished to seize the opportunity of communicating publicly with, as well that I might gratify my affection towards you, as well as, that expectation being raised respecting you, you might by some tie, and that no ungrateful one, be attached to the study of such excellent objects.

* See a letter of Thomas Molyneux, M.D., to the Bishop of Clogher, in Philosoph. Transac. No. 282.

OF SURD ROOTS.

It formerly occurred to me to think that algebraical operations would be rendered more easy, if, discarding the radical signs, some other method could be contrived of computing the roots of imperfect powers which would be less at variance with the forms used in other processes. For, as in arithmetic, fractions are rendered much more manageable by being reduced from vulgar to decimal, for then, the place of each figure serving as a denominator, they are abridged in one part and expressed as integers, and form the same sort of series as they do, and are regulated by the same rules: so if from symbolical computations we removed that radical sign ($\surd$), which, as the denominator marks the difference between integers and fractions, points out a difference in treating radicals and surds, unquestionably the mode of treating them would be simplified.

Wherefore should we not, therefore, designate surd roots like rational, merely by letters, and substitute c or d for $\surd b$? for if they were expressed in this way there will be no distinction between them and the roots of perfect powers, and addition, subtraction, multiplication, &c., will be managed in the same manner in each case. But there is a ready objection, that quantities multiplied in this way confuse calculations more than radical signs do. To this I answer, a remedy can be applied if we use the letters of the Greek alphabet for expressing roots, by writing β for $\surd b$, γ for $\surd d$, &c.; in which way not so much the letters themselves as the characters will be varied, and each substituted figure will so far correspond to the primitive that there will be no room for scruple. The root of a quantity produced from the multiplication or division of others, will be marked by their roots simply multiplied and divided, for instance, $\surd bc = \beta\kappa$, and $\surd\frac{bdm}{e} = \frac{\beta\delta\mu}{\epsilon}$

But if a multinomial quantity, or one consisting of many members, in which there is no unknown quantity connected by the signs + or —, be proposed, their aggregate might be expressed (as is often the case) by some one letter. For instance, let $a+b-c=g$, the root of which is γ. You will perhaps ask, what is to be done where unknown and known quantities are connected; for instance, if the imperfect power be $f+x$: for if we use ϕ and ξ as the roots of the parts, the root of the whole cannot be determined from them. Why, then, could we not render the given imperfect power equal to some perfect one; as for instance,

$f + x = ff + 2f\xi + \xi\xi$, or $fff + 3f\xi + 3f\xi\xi + \xi\xi\xi$, &c.? For then $f + x = \sqrt{f + x}$, or $\sqrt[3]{f + x}$, &c.

But it has been omitted how we are to ascertain of what sort is the root; whether quadratic, cube, or biquadratic; and whether, Greek characters being left to quadratics, others should be used for the rest. Or rather, the characters remaining the same, we should by means of one point placed above, denote a square root, by two a cube root, by three a biquadratic root, &c.; in the same way as first, second, third, &c., fluxions are expressed. Or, finally, should consider it sufficient that the denominator of the root might appear by retrogression; since in the course of the operation it is of no import of what kind the root may be, since all expressed without a radical sign are subject to the same laws, and treated in the same manner.

These things are, indeed, crude and imperfect; and I am aware of how little value is that which I am proposing. But you, illustrious youth, who have both leisure and abilities, can perhaps extract some good from this refuse. However I am not certain whether the thing which we have been discussing may not be of some use to beginners, for I know others will little regard them; and whether by their aid the thread of analytic investigation may not be disentangled when the radical sign being laid aside, the heterogeneous operations which accompany it may also disappear. However this may be, I am convinced that these being partially set forth, I could more briefly and clearly explain the common theory of surds than I am aware that it has been done by any one. I now proceed to do it.

Surd roots are said to be commensurable when their mutual ratio can be expressed by rational numbers, but if this cannot be done they are called incommensurable. If there be given two surd roots, and it be required to ascertain whether they be commensurable or not, let there be found an exponent of the ratio existing between the powers to which the radical sign is prefixed; if this be a perfect power, having the same index as the proposed roots, they will be commensurable; but otherwise, then they should be regarded as incommensurable. For instance, let the proposed roots be $\sqrt[3]{24}$ and $\sqrt[3]{54}$, the fraction $\frac{4}{9}$ squared, expresses the ratio of one power, 24, to the other, 54; and consequently the roots are commensurable: that is to say, $\sqrt[3]{24} : \sqrt[3]{54} :: 2 : 3$. Let $\sqrt[3]{320}$ and $\sqrt[3]{135}$ be the given quantities, the ratio of the number 320 to 135 is expressed by $\frac{64}{27}$, a perfect cube; the root of which, $\frac{4}{3}$, indicates the ratio of the one root, $\sqrt[3]{320}$, to the other, $\sqrt[3]{125}$. The demonstration is manifest, since all know that square roots are in subduplicate ratio, cube roots in subtriplicate, biquadratic in subquadruplicate, and so on of the respective powers.

If the roots, the ratio of which is required, be heterogeneous, they should be reduced to one kind by involving the numbers affixed to the radical sign, each according to the index of the other root, which being thus involved, the radical sign is to be prefixed, with an index produced by multiplying together the indexes originally given. For instance, let the heterogeneous surd roots be $\sqrt[3]{5}$ and $\sqrt[3]{11}$; if 5 be cubed and 11 be squared, they will become 125 and 121. The radical sign, prefixed with the index 6, produces the homogeneous roots $\sqrt[6]{125}$, $\sqrt[6]{121}$. That the reason of this operation may be perceived, let $\sqrt[3]{5}$ be denoted by some simple sign, suppose b, and $\sqrt[3]{11}$ by c, and $\sqrt[3]{bb}$ will be $= \sqrt[3]{5}$, and $\sqrt[3]{ccc} = \sqrt[3]{11}$, and $\sqrt[6]{bbbbbb} = \sqrt[6]{125}$, and $\sqrt[6]{cccccc} = \sqrt[6]{121}$; where it is plain that $\sqrt[6]{bbbbbb} = \sqrt[3]{bb}$, $\sqrt[6]{cccccc} = \sqrt[3]{cc}$.

As to the addition of surd roots, if they are commensurable it is done by prefixing the sum of the terms to the radical sign of the ratio, under which the common divisor is to be placed, by means of which the terms of the common ratio were denoted. For instance, $\sqrt[3]{24} + \sqrt[3]{54} = 5\sqrt[3]{6}$. For, from what has been already observed, and from what follows concerning multiplication, $\sqrt[3]{24} = 2\sqrt[3]{6}$, and $\sqrt[3]{54} = 3\sqrt[3]{6}$. In the same way is subtraction managed, only that the difference of the terms is prefixed to the radical sign of the exponent. If incommensurable surd roots are to be added or subtracted, they should be connected by the signs + or —. For instance, $\sqrt{6} + \sqrt{3}$ and $\sqrt{6} - \sqrt{3}$, are the sum and difference of the roots of the numbers 6 and 3; in which way, also, rational numbers are added to or subtracted from surds. If the surd root is to be multiplied by another homogeneous, the radical sign and the common index should be prefixed to the rectangle of the powers. For instance, the $\sqrt[3]{3} \times \sqrt[3]{7} = \sqrt[3]{21}$, and $\sqrt[3]{g} \times \sqrt[3]{x} = \sqrt[3]{gx}$. For demonstrating which operation, let the roots of the numbers 3 and 7 be denoted by b and d, so that $bb = 3$ and $dd = 7$, and it is manifest that $\sqrt[3]{bbdd} = bd$; that is, the square root of the product is equal to the products of the square roots. The same thing can be demonstrated in the same way concerning any other roots, cubic, biquadratic, &c. Heterogeneous roots, before they are multiplied, should be reduced to homogeneous. If a rational number is to be multiplied into a surd, it should be raised to a power of the same denomination with the given imperfect one, to which is prefixed the radical sign and the index of the same power, and then proceed as before. For instance, $5 \times \sqrt[3]{4} = \sqrt[3]{125} \times \sqrt[3]{4} = \sqrt[3]{500}$; or more compendiously thus: $5\sqrt[3]{4}$, and generally $b \times \sqrt[n]{c} = \sqrt[n]{b^n c}$, or $b\sqrt[n]{c}$.

As to division, as often as the dividend and divisor are both surd roots, having removed what is heterogeneous, if there be any, the radical sign prefixed to the quotient of the powers, with

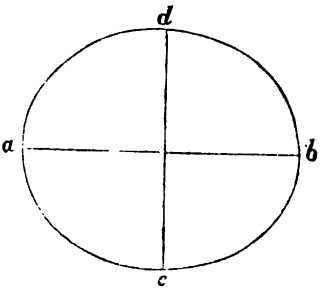
the proper index, will exhibit the required quotient. For instance $\sqrt[3]{7} \div \sqrt[3]{3} = \sqrt[3]{\frac{7}{3}} = \sqrt[3]{2\frac{1}{3}}$. But if of two numbers only one be under the radical sign, the other, involved according to the index of the given root, should be placed under the radical sign, and proceed as before. For instance, $\sqrt[3]{96} \div 4 = \sqrt[3]{96} \div \sqrt[3]{64} = \sqrt[3]{\frac{96}{64}} = \sqrt[3]{\frac{3}{2}}$; or without preparation, $\frac{\sqrt[3]{96}}{4}$; and generally $\sqrt[n]{c} \div b = \sqrt[n]{\frac{c}{ba}}$ or $\frac{\sqrt[n]{c}}{ba}$. These are, as well as the former, easily demonstrated.

ON THE ATMOSPHERIC TIDE.

Some time since I met with a book bearing the title, "On the Influence of the Sun and Moon on the Human Body," by an eminent doctor of medicine and F.R.S. I am well aware how celebrated he is and how insignificant I am. But that I may freely declare my opinion, I thoroughly receive the opinion concerning the atmospheric tide as he there explains it, and how it is based on the principle of the celebrated Newton. I am not, however, convinced that the ingenious author has rightly ascertained the causes of some phenomena connected with it. How far my doubts may be well founded, you, with whose acuteness I am well acquainted, will best judge.

That eminent man considers that there is a swelling out of the spheroidal figure of the earth about the equinoctial line. He attributes to the same cause the difference between the swelling of the air caused in the oblique sphere by the meridional, and (if I may use the expression) antimeridional moon. But I do not think that the explanation of either of those phenomena should be sought in the oblate spheroid. On this account, because though the opinion that the aëreo-terrestrial mass is of that figure is supported both by mathematical and physical grounds, and also agrees well with some phenomena, still it is not so fully received by all, but that some, and those of note too, hold the opposite opinion. And indeed I remember that Mr. Chardellou, who is profoundly skilled in astronomy, informed me that he had ascertained that the axis of the earth is longer than the diameter of the equator, and consequently, that the earth is a spheroid, but such as Burnet describes it, rising at the poles and lower at the equator. But as for me, I would rather call in question the observations of that eminent man, than reject the arguments for the earth being oblate. Still since that opinion does not equally please all, I should be reluctant to adopt it as a principle for explaining any phenomenon,

unless the thing could not otherwise be explained. But in the next place, so far from the explanation of the above-mentioned effects requiring necessarily a spheroidal figure of the earth, that it gains not a particle of light from it, and I will try to show this, by adding what that eminent man writes on the subject: "The air rises above its usual level about the two equinoxes, because when the equinoctial line corresponds with that circle of the terrestrial globe which has the greatest diameter, each of the heavenly bodies, while in it, is nearer to the earth." On the Influence of the Sun and Moon, p. 9. However, it may be well doubted, whether that nearer position of the luminaries be adequate to raise the air above the usual level. For so slight is the difference between the transverse and conjugate axis of the ellipse, by the revolution of which the terrestrial spheroid is generated, that it approaches very near to a sphere. But that we may consider the question more accurately, let *a c b d* denote a section of the aereo-terrestrial mass through the poles, *d c* being the axis, *a b* the diameter of the equator. Now by calculation I have ascertained, that the attractive power of the moon is not $\frac{1}{1000}$ part stronger at *a* or *b* than it would be at *c* or *d* if it directly were above either pole,



and, therefore, that so small a difference would be altogether unequal to producing any sensible effect. It should also be considered, that the moon is never distant from the equator a third part of the arc *b d*, and that consequently the aforesaid difference must be still very much restricted. But what we have said of the moon must be still further the case as to the sun, since it is many times further distant. It is true indeed that Dr. Mead has adduced, besides other causes of the tide being higher near the equinoxes, to wit, "the greater agitation of a fluid spheroid revolving in a greater circle, besides the centrifugal force having a much greater influence there." As to the first, although at first it appears of some import, I must confess that I do not altogether perceive how any thing bearing on the distinct explanation of the subject can be concluded from that. As to the second, it is plain that the centrifugal force is far the greatest near the equator, and on that account that the aereo-terrestrial mass has the figure of an oblate spheroid; but I do not see what consequence results from this. But although we should allow that the air, for the causes mentioned by this eminent man, should about the equinoxes swell out near the equator, it does not, however, appear thence,

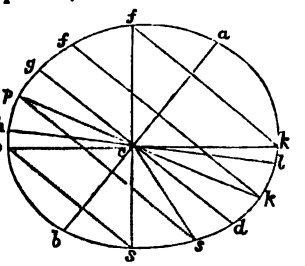
how with us, who live so far from the equator, it then should be higher than usual, but rather the contrary seems to follow. Mead writes thus in the following page: "To conclude, in the same parallels where the declination of the moon is towards that pole of the heavens which rises highest, the attraction is the strongest, when it comes to the meridian of the place, but least, when it comes to the meridian of the opposite place; the contrary of which happens in the opposite parallels. The cause is in the spheroid figure of the earth and atmosphere." But I do not think that the cause is in the figure of the earth and ambient atmosphere, because if we assume the earth to be perfectly spherical or even oblong, the same thing will certainly happen, as will be shown below.

It remains for me to attempt the explanation of these things, especially on this account, because a reason drawn from the spheroidal figure of the earth was regarded by me with suspicion; for without taking it at all into account, the affair could be most clearly and easily explained.

Newton, in his Physico-mathematical work, book iii., prop. 24, where he explains the phenomena of the tides of the sea, has this passage: "The influence of each luminary also depends on its declination, or distance from the equator. For if the luminary were placed at the pole it would constantly attract every particle of water without increase or diminution of its action, and so would cause no reciprocation of motion. Therefore the luminaries, in proceeding towards the pole from the equator, will gradually lose their effects, and on that account will cause less tides in the solstitial than in the equinoctial syzygies." But no other cause need be sought for any phenomenon of the atmospheric tide, than is sufficient for producing a similar effect in the tide of the sea. But that I may explain more fully that which has been rather briefly, and therefore obscurely by the most eminent man in the world, in the former figure let *a d b c* be the meridian, and *a b* the axis of the aereo-terrestrial mass, and let the sun and moon be conceived to be placed at the poles. It is clear that each part of the aerial mass, *d* for instance, during the diurnal revolution retains an equal distance from the luminary, and so is equally attracted towards their bodies; so that the air is not at one time elevated, at another depressed, but through the whole day remains at the same altitude. But secondly let *a c b d* represent the equator, or some parallel, and let the luminaries be in the equinoctial plane; at that time it is plain that the equator itself, as well as each parallel, assumes an elliptical figure. It is manifest also that the air which now is at *a*, the summit of the transverse axis, and is the highest six hours afterwards, will be at *c*, the extreme of the conjugate axis and lowest, and that the greatest reciprocation of motion results.

To finish the whole work at once, let us suppose the swellings of the tidal spheroid to have a threefold position, either in the poles, or in the equator, or in the intermediate parts. In the first case, the plane of diurnal rotation would be perpendicular to the axis of the spheroid, and therefore a circle; whence there would be no tide; in the second, it would be parallel to the same, and consequently an ellipse, between the axes of which would be the greatest difference, consequently the tides would be greatest; in the third, in proportion as it approached nearer to the perpendicular position, it would be more nearly a circle, and consequently the tides would be less.

It remains that I should demonstrate that the difference which exists in an oblique sphere between any tide and the following one, when the moon is away from the equator, will result indifferently, the earth being assumed either oblate, or exactly spherical, or oblong. Let *a b* be the axis of the world, *g d* the equator, *k* any place, *f k* the parallel of the place, *h l* the axis of the tidal spheroid, swelling on both sides principally by the influence of the moon. Let the moon's place be near *l*. It is to be demonstrated that *c k*, the height of the air when the moon is near the meridian, is greater than *c f*, the height of the air when the moon has passed the meridian of the opposite place. Let *p s* be drawn, a parallel corresponding to the former on the opposite side, and let *c k c f* be produced to *p* and *s*. By construction the arc *p h* is equal to the arc *k l*, therefore the arc *f h* is greater than the arc *k l*; therefore on account of the ellipse the right line *f s* is less than the right line *k p*, and *f c* less than *k c*. Q. E. D.



OF THE EQUILATERAL CONE AND CYLINDER DESCRIBED ROUND THE SAME SPHERE.

LEMMA.

THE side of an equilateral triangle is to the diameter of the inscribed circle as $\sqrt{3}$ to 1, and the perpendicular, let fall from any angle to the opposite side, is to the same as 3 to 2.

These things are plain to any one at all acquainted with algebra and geometry.

PROBLEM.

To find the ratio between the cylinder and equilateral cone circumscribed about the same sphere.

Let the diameter and periphery of the base of the cylinder be each unity. Then by lemma the diameter and the periphery of the base of the cone will be each $\sqrt{3}$. Then $1 \times \frac{1}{4} = \frac{1}{4} =$ base of cylinder; and $\frac{1}{2} =$ the sum of the bases. And $\sqrt{3} \times \frac{1}{4}\sqrt{3} = \frac{3}{4} =$ base of the cone, and surface of the cylinder, or four times the base is equal to 1. And the simple surface of the cone is equal to $\frac{3}{2} = \frac{\sqrt{6}}{4} \times \sqrt{6}$; for $\sqrt{\frac{3}{2}}$ (that is, a mean proportional between $\sqrt{3}$, the side of the cone, and radius of the base or $\sqrt{\frac{3}{4}}$) is the radius of a circle equal to the surface of the cone; and by the preceding $1 + \frac{1}{2} = \frac{3}{2} =$ surface of whole cylinder, and $\frac{3}{2} + \frac{3}{4} = \frac{9}{4} =$ surface of whole cone. Consequently by lemma and hypothesis the axis of the cylinder is 1, and of the cone $\frac{3}{2}$. But the solid contents of the cylinder $= \frac{1}{4} \times 1 = \frac{1}{4}$, and the solid contents of the cone $= \frac{3}{4} \times \frac{1}{2} = \frac{3}{8}$. Hence, the homogeneous quantities being compared together, there will result the following.

THEOREM.

Between an equilateral cone and cylinder circumscribed about the same sphere, there is the same sesquialterate ratio as to the whole surfaces, the solids, altitudes, and bases. Two years ago I discovered that theorem to my no small surprise. I did not wonder at my own talents or peculiar sagacity, as the thing is so easy, but merely that Tacquet, a celebrated professor of mathematics, prided himself so much on a discovery, to which a beginner is competent. His discovery, which is but a part of that stated above, is, "that an equilateral cone is sesquialterate in solid contents and entire surface, of a cylinder circumscribed about the same sphere," and that consequently, "there is a continued ratio" between an equilateral cone, cylinder, and sphere.

This is that proposition, to which reference is made by the figure, which is with an inscription placed on the title page of that author's work on the select theorems of Archimedes. The reader may still further consult what the Jesuit states in his preface, in the scholium to Prop. 32, and at the end of the 44th proposition of the same work, where he puts forward his theorem as a wonderful invention, and rivalling those of Archimedes. And not only Tacquet, but the celebrated Wallis also, brings it out in the additions and emendations to the 81st chapter of his Algebra, as having been demonstrated by Caswell by means of the arithmetic of infinites; which is also done, as to one part, by

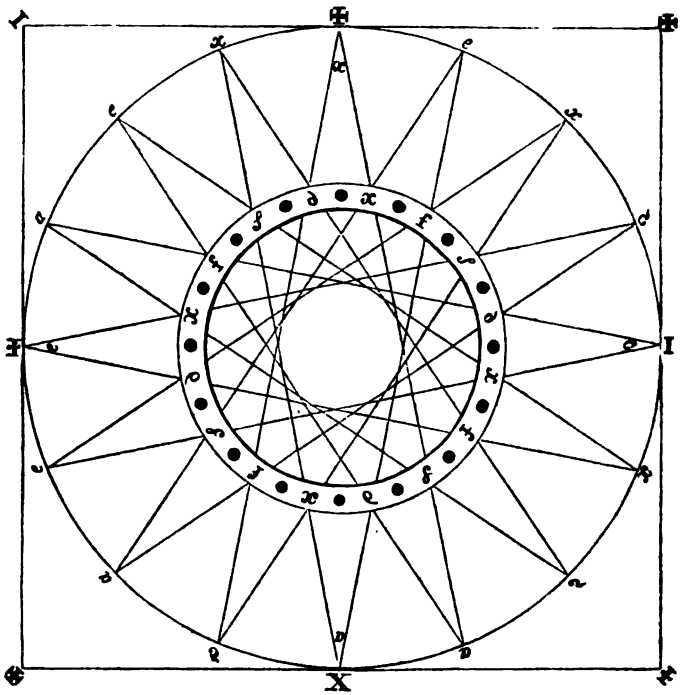
Dechales, in the 20th proposition of his book about indivisibles. However, the method of indivisibles and the arithmetic of infinites founded on it, are by some scarcely allowed to be geometrical.

But the whole theorem has been demonstrated before by no one that I know. However, if it be true, as Tacquet thinks, that amongst the other various and celebrated discoveries of Archimedes, he was most pleased with that in which he shows that the cylinder is sesquialterate of the inscribed sphere in solid contents and surface, because there is one connected proportion of the bodies and of the surfaces containing them. If this was the reason that he wished the cylinder circumscribed about the sphere to be sculptured on his tomb, what would the old Sicilian have done had he discovered that the one connected proportion held in a fivefold respect as to the two bodies. But we have just noticed how easily that follows from his inventions.

In much the same way as we have done that, it will not be difficult to discover and demonstrate all the theorems which Tacquet annexes to the Archimedean, and a hundred more of the same sort, if necessary.

ON THE ALGEBRAIC GAME.

I INVENTED the algebraic game about the same time that I did that theory. For when I saw some of my acquaintance, perhaps for half a day, intent on chess, wondering at their close pursuit of trifling, I asked what it was on which they were so closely occupied, and was answered, a delightful exercise of the mind. Turning this over in my thoughts, I wondered why so few applied their minds to mathematics, a pursuit at once so pleasing and so useful. Is it on account of difficulty? but many have great abilities, and decline no toil in trifles. Or is it because it is not a pleasing exercise of the mind? But what discipline or occupation whatsoever, I would ask, could better exercise skill, penetration, sagacity, every faculty of the mind? Are mathematics a game? They are no less agreeable; however, if they were to present themselves in that guise, perhaps those nice fellows, who spend their time in games, might devote themselves to this study. To this was added, the advice of that profound thinker, John Locke, on a similar occasion. I then contrived the following game as an exercise in algebra, with no great reach of mind, I allow, but such as will, I hope, easily be excused in a youth, especially one engaged in other studies.



Algebraical problems consist of given equations, which in determinate questions bring out sought quantities equal to a number. But each equation consists of two members, connected by a sign of equality, in each of which are for consideration, first, the sorts, whether they denote given or sought quantities; then, the signs by which they are connected. It is our object, then, to contrive that all these come out, to produce questions from chance, and a game, as well from the formation of the questions as from their solution. On a small board, such as is commonly used for the game of draughts, or of chess, let there be marked out a circle, inscribed in a square, and every thing set down as in the adjoining plan, except that in place of black spots there should be holes. We then shall have the table for the game. There should also be provided a slender peg of wood, which could fit in any of the holes. We now shall proceed to explain the use of these.

It may be observed that the symbols of calculation are set down at the sides and angles of the squares; moreover the sides give signs to the first, the angles to the latter members of equations. The inscribed circle is divided by sixteen points into as many equal parts, so that three points are directed to

each side and angle, but some directly, some obliquely. Those which are directed obliquely to any side or angle, are common to the side and angle, but those which directly point to any side belong to no angle, but are referred equally to each adjacent one; and *vice versâ*, those which are directly pointed towards any angle belong to no side, but are to be considered referable equally to each of the adjacent ones.

In forming, then, the question, our attention should be first directed to the point which the peg marks, and the side and angle to which it belongs. These signs should be noted as those which, as we have said, connect the sorts of each member of the equation; then the peg being placed at the letter written at the said point number 1, and that being transferred to the opposite side by means of the direction of right line (as the astrologers do, assigning the reason of names by which feasts are designated) number 2. Then proceeding to the other extremity of the line, as if it were continued through the intermediate ring number 3, and so on, until the letter adjacent to the first point recurs, and so on. Hence descending by the right line to the point terminated in the convexity of the interior circle, fix the peg in either adjacent hole. The number last enumerated will show how many sought quantities, or, which is the same, how many given equations there are in the question. The former members of these are constituted by the unknown quantities taken alternately, and connected with the lateral sign, the latter, by the unknown or known quantities (as may be determined by the letter written at the internal point) connected with the sought by the angular. Moreover, *d* shows that various sorts of known quantities are to be used, *s* that only one, *f* the numeral figures 2, 3, 4, &c., *x* that the sought quantities are to be repeated. But it is to be observed, in the latter member of each equation no other unknown quantities are set down than those which are found in the first member of the following equation. What has been said will be illustrated by examples.

Let us say now, that the peg occupies the hole marked by a star, and the point to which it refers will belong to the side, the sign of which is +, and to the angle, the sign of which is ×; which signs I set down on paper, the lateral on the left, or first, then the angular. Moreover, *e* is written at the point at which I reckon 1; thence (but it is allowable of two lines to follow the direction of either) proceeding towards the left, I come on *a*, at which I reckon 2; thence, turning to *z*, I reckon 3; then, proceeding across, I meet with *e*, the letter placed at the first point, at which, reckoning 4, I proceed directly to the interior point marked by the letter *d*. There will, therefore, be four sought quantities in the question; which, connected alter-

nately by the lateral sign +, will constitute the first members of the given equation. But the latter will be constituted of various known and unknown quantities (on account of d), connected by $\times$, the angular sign, in this way:—

$$\begin{array}{ll} a + e = yb & a = ? \\ e + y = zc & e = ? \\ y + z = ad & y = ? \\ x + a = ef & z = ? \end{array}$$

Wherefore, if we say that the peg is in the preceding hole, so that it will directly be directed to the lateral +, and we follow the direction of the left line, there will result three quantities to be investigated; and the interior point will have the letter f. Whence the number of the given equations, and the signs of the former members of the same, and the species of the latter are determined. But since in this case the point is circumstanced indifferently with respect to the two adjacent angles, therefore their signs are to be employed alternately; from which conditions results a question of this kind:—

$$\begin{array}{ll} a + e = 2y & a = ? \\ e + y = 3 - a & e = ? \\ y + a = 4e & y = ? \end{array}$$

But if we say that the peg is to be fixed in the following hole, the peg point should be directed towards + angular, and will equally have reference to the lateral signs + and —. Then, if you be inclined to take the right path, according to the rules laid down above, the following question will result:—

$$\begin{array}{ll} a + e = ey & a = ? \\ e - y = ay & e = ? \\ y + a = ae & y = ? \end{array}$$

* But it should first be observed, that the rules laid down admit some variety in the combinations of signs and sorts, whence it is that the point and direction being determined, various questions arise.

Secondly, that although we have already said, that a stop should be made at the recurrence of the first letter, that rule, however, can be changed at the will of each; so that we may proceed until a, e, z, x, successively turn up, or some of them twice; or until we reach some other limit. But we hasten to the game. First, then, let some of the players form a question for himself, according to the method just laid down. The other must do the same, then, by the same rules. So the question of each being made out, each should set himself about the solution of that which chance has given him. Then let each set down a fraction, the numerator of which is to be the number of quanti-

* See Appendix.

ties sought in his problem, and the denominator the number of degrees or equations which, whilst the question was solving, he set down on paper. He is to be the winner whose fraction is the largest.

Then, if fugitive quantities elude the eager algebraist, he must be considered to have lost all hope of victory. Nor altogether unreasonably, since it must happen rather by the fault of the selector than by mischance, that the question is undeterminate.

As often as in the sport we come to an equation adfected beyond quadratic, there will be no need of a tedious process, or construction by parabola; it is sufficient if an unknown root, its kind being changed, be regarded as known.

The solution of all the questions being finished, each should examine the work of the other, for which purpose parchment margins are convenient. As to pledges and fines, each may settle that as he pleases, for I leave these to others.

As regards the problems, they are not difficult, for otherwise they would be ill suited for amusement; but they are of that kind the solution of which will redound to the great advantage of the players whilst they strive to reach the proper path, whilst they, in their minds, run over long trains of consequences, and try to comprehend the whole series of analysis in a very brief glance. Permit me now, excellent youth, briefly to address others, for you, whom the difficulty itself attracts, have no need of an exhorter. I address you, college youths, who have energy of mind, sagacity, and penetration, but are averse from sad seclusion in the study and the lives of those generally called *Pumps*, thinking better to show your talents among your fellow idlers in play and games. You see what a mere game is algebra, and that both chance and science find place in it. Why should you not, then, come to this gaming table? For you need not here dread that which happens in cards, chess, draughts—that whilst some play others stand idly by; for whoever wish to play, can at once play and study; and some, too, make a little money. But I think I hear some one exclaiming in these words, Do you think that we can be deceived? We are not to be lured by presenting the appearance of a game, into learning a very difficult science, which must be mastered with great pains. I answer, that algebra is so far difficult as is required for a game; for if you take away all difficulty, you also take away all recreation and amusement. For all plays are so many arts and sciences. Nor is there any distinction between this and the others, but that they only regard present gratification; but from this, besides most delightful occupation, other abundant fruits are obtained. But, so far is this from having a pernicious tendency, that he is in every respect praise-

worthy, according to the expression of the poet, "and has gained every point, who has combined the useful with the agreeable."

But what are those fruits which you extol? To enumerate them, mathematics in all their extent; the arts and sciences, advancing civil and military affairs, should be reviewed. For through all these is diffused the wonderful power of algebra. It is styled by all, the great, the wonderful art, the highest pinnacle of human knowledge, the kernel and key of all mathematics; and, by some, the foundation of all sciences. And, indeed, how difficult would it be to assign the limits of algebra, when it has latterly extended to natural philosophy and medicine, and daily sets about the most valuable arguments. That I may pass over other things, in the Philosophical Transactions, No. 257, there are algebraic theorems on the certainty of human evidences and traditions; and it may be laid down for certain that wherever greater and less are brought forward, wherever any ratio or proportion can be admitted, there algebra finds a place.

But perhaps some one may say, that he cares neither for mathematics, nor for any thing treated mathematically. Be it so; let us so far indulge the desire, the ignorance of persons; for I venture to maintain that this contempt proceeds from ignorance of the most exalted pursuits, and "which distinguish us from barbarians."* But is there any one who thinks slightingly of a capacious intellect, a sagacious genius, a sound judgment? If there be any one so devoid of reason, let him then disregard mathematics, the great importance of which, for forming all the best habits of the mind, is allowed by all.

Bacon somewhere, in what he has written concerning the advancement of knowledge, has observed a sort of analogy between the play of hand-ball and mathematics. To wit, as by means of that, besides the pleasure primarily aimed at, we obtain other more valuable objects, agility and strength of body, quick-sightedness; so mathematical studies, besides their proper aims and uses, have that collateral one, that they abstract the mind from the senses, sharpen and confirm the talents. The ancients formerly, the wiser of the moderns now, allow this. The efficacy of algebra in rearing the intellectual powers is shown, amongst others, by Descartes, and more at length by Malbranche's Inquiry into Truth, book vi., part i., chap. 5, and part ii., chap. 8; and many other places. And those excellent rules which, in book vi., part ii., chap. 1, he lays down to be observed in the solution of questions, and which are so admirable, that an ingenious author considers that an angel could not give better; these angelic rules, I say, seem taken from algebra.

* See an Essay in English, on the Gardens of Epicurus, by Sir William Temple, Bart.

Why need I mention others, when John Locke, who, if any one did, knew well all the defects of the human intellect and their remedies, recommends, as infinitely useful, the study of mathematics in general, and of algebra especially, to all raised above the populace? See his Posthumous Works, pp. 30, 31, 32, &c., Treatise on the Conduct of the Understanding, a small and imperfect work, indeed, but which may well be preferred to the vast and elaborate volumes of others. But an author of great name thinks that mathematical pursuits require too severe meditation, and which is less suitable for a man of rank and devoted to pleasure. I answer, as Locke exhorts, that the judgment of the dissentient, St. Evremont, is set against it to no purpose. For he must be regarded an incompetent judge who, as is most probable from his life and writings, had scarcely entered the threshold. But if the bark seem hard and dry, what wonder is it? But that I may state the affair as it is, the best way is that each, making trial of the matter, follow their own judgment. Nor is there reason for raising up great difficulties because the word algebra has I know not what harsh and fearful sound. For any one can, in the short space of a month, learn the art as far as may be requisite for the game.

Having now explained our game and views, I request the mathematical reader to receive candidly these scanty first-fruits of my studies, as I will probably produce others better hereafter. For the present other studies engage, which, dry and jejune enough, have taken the place of delightful mathematics. In the meantime do you, excellent youth, accept this rhapsody of trifles as a sort of emblem of regard for yourself. Adieu.

APPENDIX.

THAT any one may fully comprehend my purpose, I have thought it advisable to place before the view, in the following pages, all the variations of combinations and sorts in the questions which the above-stated conditions of playing admit of.

But it should be observed, in the first place, that the following formulæ, according to the modes of combination and sorts of quantities, but not all according to the number of the given equations, belong to the respective points; for often more than three quantities are to be investigated.

Secondly, that as all formulæ of questions may be had, various limits are to be laid down; otherwise only two of the four classes can belong to any one point.

I call the first point that which is directed to the lateral +, the second that next to it on the right, and so on.

TO THE READER.

I HAVE sometimes regretted too late to have given forth these efforts of my youth, struggling for some knowledge of mathematics only occasionally, and from my own resources. And I would still regret it, but that hence has arisen an occasion of emulation for a noble pair of geniuses, growing up as the hope of the rising generation. Nor do I boast any other claim on the republic of letters. Let these things be considered a deprecation of envy, of censure, on account of my rashness; if, indeed, I have given occasion of any.

First Point.

$$
\begin{array}{ll}
 & a+e=b\times ee-bb\times yy-be\times bb-ey\times bb-y \\
 & e+y=b-yy\times bb-aa\times by-bb\times ya-bb\times a \\
s & y+a=b\times aa-bb\times ee-ba\times bb-ae\times bb-e
\end{array}
$$

$$
\begin{array}{ll}
 & a+e=b\times ee-bb\times yy-be\times bb-ey\times bb-y \\
 & e+y=c-yy\times cc-aa\times cy-cc\times ya-cc\times a \\
d & y+a=d\times aa-dd\times ee-da\times dd-ae\times dd-e
\end{array}
$$

$$
\begin{array}{ll}
 & a+e=2\times ee-22\times yy-2e\times 22-ey\times 22-y \\
 & e+y=3-yy\times 33-aa\times 3y-33\times ya-33\times a \\
f & y+a=4\times aa-44\times ee-4a\times 44-ae\times 44-e
\end{array}
$$

$$
\begin{array}{ll}
 & a+e=e\times ye-ye\times yy-e \\
 & e+y=y-ay\times aa-ya\times y \\
x & y+a=a\times ea-ea\times ee-a
\end{array}
$$

Second Point.

$$
\begin{array}{ll}
 & a+e=b\times eb\times y \\
 & e+y=b\times yb\times a \\
s & y+a=b\times ab\times e
\end{array}
$$

$$
\begin{array}{ll}
 & a+e=b\times eb\times y \\
 & e+y=c\times yc\times a \\
d & y+a=d\times ad\times e
\end{array}
$$

$$
\begin{array}{ll}
 & a+e=2\times e2\times y \\
 & e+y=3\times y3\times a \\
f & y+a=4\times a4\times e
\end{array}
$$

$$
\begin{array}{ll}
 & a+e=e\times y \\
 & e+y=y\times a \\
x & y+a=a\times e
\end{array}
$$

Third Point.

$$
\begin{array}{ll}
 & a+ea-e=e\times by\times b \\
s & e-ye+y=y\times ba\times b \\
 & y+ay-a=a\times be\times b
\end{array}
$$

$$
\begin{array}{ll}
 & a+ea-e=e\times by\times b \\
d & e-ye+y=y\times ca\times c \\
 & y+ay-a=a\times de\times d
\end{array}
$$

$$
\begin{array}{ll}
 & a+ea-e=e\times 2y\times 2 \\
f & e-ye+y=y\times 3a\times 3 \\
 & y+ay-a=a\times 4e\times 4
\end{array}
$$

$$
\begin{array}{ll}
 & a+ea-e=e\times y \\
x & e-ye+y=y\times a \\
 & y+ay-a=a\times e
\end{array}
$$

Fourth Point.

$$\begin{array}{ll} & a - e = b \times e\,b \times y \\ s & e - y = b \times y\,b \times a \\ & y - a = b \times a\,b \times e \end{array}$$

$$\begin{array}{ll} & a - e = b \times e\,b \times y \\ d & e - y = c \times y\,c \times a \\ & y - a = d \times a\,d \times e \end{array}$$

$$\begin{array}{ll} & a - e = 2 \times e\,2 \times y \\ f & e - y = 3 \times y\,3 \times a \\ & y - a = 4 \times a\,4 \times e \end{array}$$

$$\begin{array}{ll} & a - e = e \times y \\ x & e - y = y \times a \\ & y - a = a \times e \end{array}$$

Fifth Point.

$$\begin{array}{ll} & a - e = e \times b\,b \div e\,y \times b\,b \div y\,b \times e\,e \div b\,b \times y\,y \div b \\ s & e - y = y \div b\,b \times y\,a \div b\,b \times a\,b \div y\,y \times b\,b \div a\,a \times b \\ & y - a = a \times b\,b \div a\,e \times b\,b \div e\,b \times a\,a \div b\,b \times e\,e \div b \end{array}$$

$$\begin{array}{ll} & a - e = e \times b\,b \div e\,y \times b\,b \div y\,b \times e\,e \div b\,b \times y\,y \div b \\ d & e - y = y \div c\,c \times y\,a \div c\,c \div a\,c \div y\,y \times c\,c \div a\,a \times c \\ & y - a = a \times d\,d \div a\,e \times d\,d \div e\,d \times a\,a \div d\,d \times e\,e \div d \end{array}$$

$$\begin{array}{ll} & a - e = e \times 2\,2 \div e\,y \times 2\,2 \div y\,2 \times e\,e \div b\,2 \times y\,y \div 2 \\ f & e - y = y \div 3\,3 \times y\,a \div 3\,3 \times a\,3 \div y\,y \times c\,3 \div a\,a \times 3 \\ & y - a = a \times 4\,4 \div e\,o \times 4\,4 \div e\,4 \times a\,a \div d\,4 \times e\,e \div 4 \end{array}$$

$$\begin{array}{ll} & a - e = e \times y\,e \div y\,e \times y\,y \div e \\ x & e - y = y \div a\,y \times a\,a \div y\,a \times y \\ & y - a = a \times e\,a \div e\,a \times e\,e \div a \end{array}$$

Sixth Point.

$$\begin{array}{ll} & a - e = b \div e\,b \div y\,e \div b\,y \div b \\ s & e - y = b \div y\,b \div a\,y \div b\,a \div b \\ & y - a = b \div a\,b \div e\,a \div b\,e \div b \end{array}$$

$$\begin{array}{ll} & a - e = b \div e\,b \div y\,e \div b\,y \div b \\ d & e - y = c \div y\,c \div a\,y \div e\,a \div c \\ & y - a = d \div a\,d \div e\,a \div d\,e \div d \end{array}$$

$$\begin{array}{ll} & a - e = 2 \div e\,2 \div y\,e \div 2\,y \div 2 \\ f & e - y = 3 \div y\,3 \div a\,y \div 3\,a \div 3 \\ & y - a = 4 \div a\,4 \div e\,a \div 4\,e \div 4 \end{array}$$

$$\begin{array}{ll} & a - e = e \div y\,y \div e \\ x & e - y = y \div a\,a \div y \\ & y - a = a \div e\,e \div a \end{array}$$

Seventh Point.

$$
\begin{array}{ll}
 & a - ea \times e = e \div bb \div ey \div bb \div y \\
s & e \times ye - y = y \div bb \div ya \div bb \div a \\
 & y - ay \times a = a \div bb \div ae \div bb \div e
\end{array}
$$

$$
\begin{array}{ll}
 & a - ea \times e = e \div bb \div ey \div bb \div y \\
d & e \times ye - y = y \div cc \div ya \div cc \div a \\
 & y - ay \times a = a \div dd \div ae \div dd \div e
\end{array}
$$

$$
\begin{array}{ll}
 & a - ea \times e = e \div 22 \div ey \div 22 \div y \\
f & e + ye - y = y \div 33 \div ya \div 33 \div a \\
 & y - ay \times a = a \div 44 \div ae \div 44 \div e
\end{array}
$$

$$
\begin{array}{ll}
 & a - ea \times e = e \div yy \div e \\
x & e + ye - y = y \div aa \div y \\
 & y - ay \times a = a \div ee \div a
\end{array}
$$

Eighth Point.

$$
\begin{array}{ll}
 & a \times e = e \div bb \div ey \div bb \div y \\
s & e \times y = y \div bb \div ya \div bb \div a \\
 & y \times a = a \div bb \div ae \div bb \div e
\end{array}
$$

$$
\begin{array}{ll}
 & a \times e = e \div bb \div ey \div bb \div y \\
d & e \times y = y \div cc \div ya \div cc \div a \\
 & y \times a = a \div dd \div ae \div dd \div e
\end{array}
$$

$$
\begin{array}{ll}
 & a \times e = e \div 22 \div ey \div 22 \div y \\
f & e \times y = y \div 33 \div ya \div 33 \div a \\
 & y \times a = a \div 44 \div ae \div 44 \div e
\end{array}
$$

$$
\begin{array}{ll}
 & a \times e = e \div yy \div e \\
x & e \times y = y \div aa \div y \\
 & y \times a = a \div ee \div a
\end{array}
$$

Ninth Point.

$$
\begin{array}{ll}
 & a \times e = b + ee \div bb + yy \div be + bb \div ey + bb \div y \\
s & e \times y = b + yy + bb \div aa + by \div bb + ya \div bb + a \\
 & y \times a = b + aa \div bb + ee \div ba + bb \div ae + bb \div e
\end{array}
$$

$$
\begin{array}{ll}
 & a \times e = b + ee \div bb + yy \div be + bb \div ey + bb \div y \\
d & e \times y = c \div yy + cc \div aa + cy \div cc + ya \div cc + a \\
 & y \times a = d + aa \div dd + ee \div da + dd \div ae + dd \div e
\end{array}
$$

$$
\begin{array}{ll}
 & a \times e = 2 + ee \div 22 + yy \div 2e + 22 \div ey + 22 \div y \\
f & e \times y = 3 \div yy + 33 \div aa + 3y \div 33 + ya \div 33 + a \\
 & y \times a = 4 + aa \div 44 + ee \div 4a + 44 \div ae + 44 \div e
\end{array}
$$

$$
\begin{array}{ll}
 & a \times e = e + ye \div ye + yy \div e \\
x & e \times y = y \div ay + aa \div ya + y \\
 & y \times a = a + ea \div ea + ee \div a
\end{array}
$$

Tenth Point.

$$\begin{array}{ll} & a \times e = e + b\,y + b \\ s & e \times y = y + b\,a + b \\ & y \times a = a + b\,e + b \end{array}$$

$$\begin{array}{ll} & a \times e = e + b\,y + b \\ d & e \times y = y + c\,a + c \\ & y \times a = a + d\,e + d \end{array}$$

$$\begin{array}{ll} & a \times e = e + 2\,y + 2 \\ f & e \times y = y + 3\,a + 3 \\ & y \times a = a + 4\,e + 4 \end{array}$$

$$\begin{array}{ll} & a \times e = e + y \\ x & e \times y = y + a \\ & y \times a = a + e \end{array}$$

Eleventh Point.

$$\begin{array}{ll} & a \times e\,a \div e = e + b\,y + b \\ s & e \div y\,e \times y = y + b\,a + b \\ & y \times a\,y \div a = a + b\,e + b \end{array}$$

$$\begin{array}{ll} & a \times e\,a \div e = e + b\,y + b \\ d & e \div y\,e \times y = y + c\,a + c \\ & y \times a\,y \div a = a + d\,e + d \end{array}$$

$$\begin{array}{ll} & a \times e\,a \div e = e + 2\,y + 2 \\ f & e \div y\,e \times y = y + 3\,a + 3 \\ & y \times a\,y \div a = a + 4\,e + 4 \end{array}$$

$$\begin{array}{ll} & a \times e\,a \div e = e + y \\ x & e \div y\,e \times y = y + a \\ & y \times a\,y \div a = a + e \end{array}$$

Twelfth Point.

$$\begin{array}{ll} & a \div e = b + e\,b + y \\ s & e \div y = b + y\,b + a \\ & y \div a = b + a\,b + e \end{array}$$

$$\begin{array}{ll} & a \div e = b + e\,b + y \\ d & e \div y = c + y\,c + a \\ & y \div a = d + a\,d + e \end{array}$$

$$\begin{array}{ll} & a \div e = 2 + e\,2 + y \\ f & e \div y = 3 + y\,3 + a \\ & y \div a = 4 + e\,4 + e \end{array}$$

$$\begin{array}{ll} & a \div e = e + y \\ x & e \div y = y + a \\ & y \div a = a + e \end{array}$$

Thirteenth Point.

$$\begin{array}{ll} & a \div e = e + b\,b - e\,y + b\,b - y\,b + e\,e - b\,b + y\,y - b \\ s & e \div y = y - b\,b + y\,a - b\,b + a\,b - y\,y + b\,b - a\,a + b \\ & y \div a = a + b\,b - a\,e + b\,b - e\,b + a\,a - b\,b + e\,e - b \end{array}$$

$$\begin{array}{ll} & a \div e = e + b\,b - e\,y + b\,b - y\,b + e\,e - b\,b + y\,y - b \\ d & e \div y = y - c\,c + y\,a - c\,c + a\,c - y\,y + c\,c - a\,a + c \\ & y \div a = a + d\,d - a\,e + d\,d - e\,d + a\,a - d\,d + e\,e - d \end{array}$$

$$\begin{array}{ll} & a \div e = e + 2\,2 - e\,y + 2\,2 - y\,2 + e\,e - 2\,2 + y\,y - 2 \\ x & e \div y = y - 3\,3 + y\,a - 3\,3 + a\,3 - y\,y + 3\,3 - a\,a + 3 \\ & y \div a = a + 4\,4 - a\,e + 4\,4 - e\,4 + a\,a - 4\,4 + e\,e - 4 \end{array}$$

$$\begin{array}{ll} & a \div e = e + y\,e - y\,e + y\,y - e \\ x & e \div y = y - a\,y + a\,a - y\,a + y \\ & y \div a = a + e\,a - e\,a + e\,e - a \end{array}$$

Fourteenth Point.

$$\begin{array}{ll} & a \div e = b - e\,b - y\,e - b\,y - b \\ s & e \div y = b - y\,b - a\,y - b\,a - b \\ & y \div a = b - a\,b - e\,a - b\,e - b \end{array}$$

$$\begin{array}{ll} & a \div e = b - e\,b - y\,e - b\,y - b \\ d & e \div y = c - y\,c - a\,y - c\,a - c \\ & y \div a = d - a\,d - e\,a - d\,e - d \end{array}$$

$$\begin{array}{ll} & a \div e = 2 - e\,2 - y\,e - 2\,y - 2 \\ f & e \div y = 3 - y\,3 - a\,y - 3\,a - 3 \\ & y \div a = 4 - a\,4 - e\,a - 4\,e - 4 \end{array}$$

$$\begin{array}{ll} & a \div e = e - y\,y - e \\ x & e \div y = y - a\,a - y \\ & y \div a = a - e\,e - a \end{array}$$

Fifteenth Point.

$$\begin{array}{ll} & a \div e\,a + e = e - b\,y - b\,b - e\,b - y \\ s & e + y\,e \div y = y - b\,a - b\,b - y\,b - a \\ & y \div a\,y + a = a - b\,e - b\,b - a\,b - e \end{array}$$

$$\begin{array}{ll} & a \div e\,a + e = e - b\,y - b\,b - e\,b - y \\ d & e + y\,e \div y = y - c\,a - c\,c - y\,c - a \\ & y \div a\,y + a = a - d\,e - d\,d - a\,d - e \end{array}$$

$$\begin{array}{ll} & a \div e\,a + e = e - 2\,y - 2\,2 - e\,2 - y \\ f & e + y\,e \div y = y - 3\,a - 3\,3 - y\,3 - a \\ & y \div a\,y + a = a - 4\,e - 4\,4 - a\,4 - a \end{array}$$

$$\begin{array}{ll} & a \div e\,a + e = e - y\,y - e \\ x & e + y\,e \div y = y - a\,a - y \\ & y \div a\,y + a = a - e\,e - a \end{array}$$

Sixteenth Point.

$$\begin{array}{ll} & a+e=e-by-bb-eb-y \\ s & a+y=y-ba-bb-yb-a \\ & y+a=a-be-bb-ab-e \end{array}$$

$$\begin{array}{ll} & a+e=e-by-bb-eb-y \\ d & e+y=y-ca-cc-yc-a \\ & y+a=a-de-dd-ad-e \end{array}$$

$$\begin{array}{ll} & a+e=e-2y-22-e2-y \\ f & e+y=y-3a-33-y3-a \\ & y+a=a-4e-44-a4-e \end{array}$$

$$\begin{array}{ll} & a+e=e-yy-e \\ x & e+y=y-aa-y \\ & y+a=a-ee-a \end{array}$$

N.B. There is also another variety in the first member of the equations, where the analytic sign is found; that is, if we transpose the sorts. For instance, if in the fourth point we use $\left\{\begin{matrix} e-a \\ y-e \\ a-y \end{matrix}\right\}$ in the twelfth $\left\{\begin{matrix} e\div a \\ y\div e \\ a\div y \end{matrix}\right\}$ the questions will be doubled.

Lest any one should perchance suppose that in our game all possible questions are exhibited by our tables, it should be observed that they are, in fact, innumerable. For these stops can be varied without end; whence arise innumerable questions, in each of which, however, no other methods are to be followed in determining signs, combinations, and sorts, than those which are set forth in the questions alone of each odd number except unit of the quantities sought, and these are accordingly exhibited in the tables which we have given.

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CONCERNING MOTION;

OR

THE ORIGIN AND NATURE OF MOTION,

AND

THE CAUSE OF COMMUNICATING IT.

CONCERNING MOTION.

1. It is of main import in searching for knowledge to take care that ill understood terms do not thwart us, a point which almost all philosophers inculcate, yet few attend to. Although it does not appear so difficult, especially in physical researches, which allow sensation, experiment, and geometrical reasoning. Laying aside, therefore, every prejudice originating either in usual modes of speaking, or in the authority of philosophers, we should diligently examine nature itself. Nor should the authority of any one be of such avail, that his words and expressions should be considered of value, unless they contain what is certain and clear.

2. The consideration of motion amazingly disturbed the minds of ancient philosophers, whence arose various opinions excessively difficult, not to say absurd, which, since they have now sunk into obscurity, do not deserve that we should give much attention to their discussion. But amongst recent and sounder philosophers of the present age, when motion is treated of, several words of too abstract and obscure signification occur, such as, "solicitation of gravity," "effort," "dead powers," and which diffuse obscurity over writings, in other respects of great learning, and give rise to opinions not less at variance with truth, than with the common sense of men. But it is necessary that these be discussed, not for the sake of confuting others, but on account of truth.

3. Solicitation and effort, or endeavour, in strict acceptation, are applicable merely to animated beings. When they are applied to others, they should be received in a metaphorical sense. Philosophers, however, have nothing to do with metaphors. But if we reject affection of the soul and motion of body, it will be clear to any one giving attention to the thing, that there is no distinct or plain meaning in those words.

4. As long as heavy bodies are sustained by us, we perceive in ourselves effort, fatigue, trouble; we also perceive in heavy bodies, when falling, an accelerated motion towards the centre of the earth, but nothing more, as far as our senses are concerned. However reason proves that there is some origin, or cause, of these phenomena, and this is generally called gravity. Since, however, the cause of the descent of heavy bodies is dark and unknown, gravity in that sense cannot be styled a sensible quality; consequently it is an occult quality. But we can scarcely conceive, and indeed not even scarcely, what is an

occult quality, and how any quality can act or effect any thing. It would be better then, if, putting the occult quality out of view, men would attend only to sensible effects; and abstract words, however useful they are in discussions, being omitted in speculation, the mind should be fixed on particular and concrete things, that is, on the things themselves.

5. Power in the same way is attributed to bodies, but that word is used as if it signified a known quality, distinct as well from figure, motion, and every thing sensible, as from every affection of animated life; but any person who accurately examines the subject will find that it is nothing else than an occult quality. Animal effort and corporeal motion are commonly regarded as symptoms and measures of this occult quality.

6. Thus it is plain that gravity or power is erroneously laid down as the origin of motion: for can that origin be more clearly known from its being called an occult quality? What is itself occult, explains nothing; putting out of view that the unknown acting cause can be better styled a substance than a quality. Moreover, power, gravity, and words of that kind, are employed more usually, and that not injudiciously, in the concrete, to denote the motion of bodies, the difficulty in resistance, &c.; but when they are used by philosophers to signify natures distinct and abstracted from all these, which are neither objects of sense, nor can be figured by any power of mind or imagination, they are sure to produce error and confusion.

7. But it leads many into error, that they find general and abstract words useful in disquisition, yet they cannot fully assign them a meaning. Indeed, they have been partly invented by common usage to abbreviate language, and have been partly devised by philosophers for the purposes of instruction; not that they are according to the nature of things, which indeed are singular and concrete, but because they are fit for communicating learning, because they render notions, or at least propositions, general.

8. We generally suppose that corporeal power is something easily conceived. Those who have given more attention to the subject think otherwise, as appears from the amazing obscurity of their expressions when they attempt to explain it. Torricelli says, that power and impulse are certain abstract and subtle things and quintessences, which are included in corporeal substance, as in the magic vase of Circe.* Leibnitz also, in Natura Vis Explicanda, has this passage: "Active, primitive power, which is ἡ πρώτη ἐντελέχεια, corresponds to soul or substantial form." See Transactions of the Learned Society, Lips. Thus must even the greatest men, when they give way to abstraction, have

* Matter is nothing but an enchanted vase of Circe, which serves for a receptacle of the force and the momenta of impulse. Power and impulse are such subtle abstracts, are quintessences so refined, that they cannot be enclosed in any other vessels but the inmost materiality of natural solids. See Academical Lectures.

recourse to words having no certain signification, and indeed mere scholastic shadows. We might bring forward other instances, and indeed no few of them, from the writings of recent authors, from which it is very clear, that metaphysical abstractions have not altogether given way to mechanics and experiment, but still give unnecessary trouble to philosophy.

9. From this source spring various absurdities, of which kind is this, that the force of percussion, however small, is infinitely great. Which indeed supposes that gravity is a substantial quality different from all others, and that gravitation is, as it were, an act of this quality substantially distinct from motion, but the least percussion produces a greater effect than the greatest gravitation without motion, for that causes some motion, this none. Whence it follows that the force of percussion exceeds in an infinite ratio the force of gravitation, that is, must be infinitely great. The experiments of Galileo should be consulted, and what Torricelli, Borelli, and others, have written concerning the definite force of percussion.

10. However it must be admitted, that no power can be by itself perceived, nor otherwise known, nor measured, than by its effect. But there is no effect of dead power, or simple gravity in a quiescent body, no change taking place, but there is some effect of percussion. Since, therefore, powers are proportionable to effects, we may conclude that there is no such thing as dead power. Nor still, that the power of percussion is infinite, for we ought not to regard any positive quantity as infinite, because it surpasses in an infinite ratio no quantity or nothing.

11. The force of gravity cannot be discriminated from momentum; but there is no momentum without velocity, for it is quantity of matter multiplied into velocity, and as velocity cannot be understood without motion, neither can the force of gravitation. Still further, no power can be known unless by action, and is measured by the same, but we cannot abstract the action of a body from motion; therefore, as long as a heavy body changes the figure of a piece of lead placed under it, or of a cord, so long is it moved; but, as long as it is quiescent, it does nothing, or, what is the same, is prevented from acting. Briefly, those words *dead power* and *gravitation*, although by metaphysical abstraction they are supposed to mean something different from what moves, from what is moved, from motion and rest, yet all this is nothing whatsoever.

12. If any one would say that a weight, whether hung or laid on a chord, acted on it in preventing its resuming its position by elasticity, I say that, by parity of reason, any lower body acts on the higher lying on it, because it prevents it from descending; but it can by no means be styled the action of a body, that it prevents another body to exist in the place which it occupies.

13. We occasionally feel the pressure of a gravitating body; but the annoying sensation results from the motion of that heavy body communicated to the fibres and nerves of our bodies, and changing their position, and consequently should be referred to percussion. In these things we encounter many and weighty prejudices; but they must be subdued by earnest and repeated thought, or, rather, totally extirpated.

14. To prove that any quantity is infinite, it should be shown that some finite homogeneous part is infinitely contained in it. But dead power is to the force of percussion, not as a part to a whole, but as a point to a line, according to those who maintain the infinite power of percussion. I might add much on this topic, but I fear to become prolix.

15. The principles laid down will put an end to some extraordinary disputes which have greatly engaged the attention of learned men. An example of these is that controversy concerning the proportion of powers. One side admitting that the quantity of matter being given, the momentum, motion, force, are directly as the velocity. But every one perceives that this opinion takes for granted that the force of a body is distinguished from its momentum, motion, and impulse; and that, that supposition being given up, it falls to the ground.

16. That it may appear still more clearly that a certain strange confusion has been introduced by metaphysical abstractions into the doctrine of motion, let us note how widely learned men differ in their opinions concerning power and impetus. Borelli asserts that impetus is nothing else than a degree of velocity. Some maintain that impetus and effort differ among themselves; others, that they do not differ. Some consider that the moving power is proportional to motion. Others maintain that there is some power besides the moving one, and which should be measured in a different manner, for instance, by the squares of the velocities into the quantities of matter. But there is no end in pursuing these things.

17. Force, gravity, attraction, and words of this sort, are serviceable for reasonings and computations concerning motion and bodies in motion, but not for understanding the simple nature of motion itself, or for denoting so many distinct qualities. Certainly, as far as regards attraction, it is clear that it is adopted by Newton, not as a real, physical quality, but merely as a mathematical hypothesis. Still further, Leibnitz, distinguishing elementary effort, or solicitation, from impetus, allows that those things are not in reality found in nature, but produced by abstraction.

18. Such also are the composition and resolution of any direct forces into any oblique ones, by the diagonal and sides of a parallelogram. These are serviceable for mechanics and computation; but it is one thing to be serviceable to computation

and mathematics, and another to set forth the nature of things.

19. Of the moderns there are many of opinion, that motion is not destroyed nor produced anew, but that there is always the same quantity of motion. Aristotle, also, proposed that question, whether motion be created and corrupt, or from eternity. That sensible motion perishes is plain from our senses; but they will have it that the same impetus, effort, or the same sum of forces, remains. Whence Borelli maintains, that force is not lessened in percussion, but expanded; also that contrary impulses are received and preserved in the same body. Leibnitz also maintains that effort is every where and always in matter. It must be allowed that these things are too abstract and obscure, and of the same sort as substantial forms and entelechiæ.

20. Those who, to explain the cause and origin of motion, make use either of the hylarchic principle, or the need of nature, or appetite, or, finally, natural instinct, should be deemed rather to have said something than to have thought any thing. Nor is there much difference between such persons and those* who suppose that the parts of the earth move themselves, or that spirits are implanted in them in the same way as are forms, and in this way assign the cause of the acceleration of heavy bodies falling; or he† who maintained that in bodies, besides solid extension, there should also be allowed something whence the consideration of forces might arise. For all these either lay down nothing particular and determinate, or, if there be any thing in what they say, it will be as difficult to explain as that very thing on account of explaining which it is brought forward.

21. It is to no purpose for explaining nature, to bring forward what is neither open to the senses nor can be understood by the reason. We should consider, therefore, what the senses, what experience, what reason, resting on them, impresses on us. There are two chief sorts of things—body and mind. By the aid of our senses we perceive something extended, solid, moveable, having figure and other qualities, the objects of our senses; and, by some internal consciousness, we know of something sentient, perceptive, and intelligent. Moreover, we perceive that these things differ widely from each other, and are thoroughly heterogeneous. I am speaking of things that are known; we need say nothing of things unknown.

22. That which we know and call body, in no respect contains any thing in itself which can be the origin or efficient cause of motion; for impenetrability, extension, figure, include or denote no power of producing motion; nay, on the contrary, examining singly not only those but other qualities of bodies, we shall find all their qualities passive, and that there is nothing in them active, and which can in any way be regarded as the source and origin of motion. As to gravity, we have shown

* Borelli. † Leibnitz.

that word to signify nothing known or distinct from the sensible effect the cause of which is the object of inquiry; and, indeed, when we call a body heavy, we understand nothing more than that it tends downwards, not regarding the cause of this sensible effect.

23. We can, therefore, without hesitation, state respecting body, that it is not the origin of motion. Wherefore, if any one maintains, that, in addition to solid extension and its modifications, the word body implies occult virtue, form, essence, he may with vain toil dispute without notions, and indulge in an abuse of words which express nothing distinctly. But the wiser course of philosophers would have been, to have abstained altogether from abstract and general notions; if, indeed, notions which cannot be understood ought to be expressed at all.

24. We know what is contained in the idea of body; but what we know in body it is clear is not the origin of motion. But those who attribute to body something unknown, of which they have no idea, and which they call the origin of motion: such persons say nothing more than that the origin of motion is unknown. But we need no longer dwell on such subtleties.

25. Besides corporeal beings, there is another class, that of thinking beings. That these have a power of moving bodies, we know by our own experience; since our minds can at pleasure excite and stop the movements of our limbs, however it is effected. This is certain, that our bodies are moved at the will of our minds, which consequently may not improperly be styled the origin of motion; a particular and subordinate one, indeed, and which itself depends on the first universal origin.

26. Heavy bodies tend downwards, although agitated by no apparent impulse. We must not, however, therefore suppose that the origin of motion resides in them; on which fact Aristotle thus reasons:—Heavy and light things, he observes, are not moved of themselves; for that would be vitality, and they could stop themselves. All heavy bodies tend to the centre of the earth, by a certain and constant law; nor is there perceived any principle or power of stopping or diminishing that motion, or of increasing it, except by a fixed proportion, or of in any way modifying it; consequently, their condition is merely passive. Moreover, the same thing should, strictly and accurately speaking, be said respecting percussive bodies. Those bodies, as long as they are moved, and also in the very moment of percussion, are as much passive as when they are at rest. A body at rest acts as much as a body in motion; as Newton admits, when he says that the force of *inertia* is the same with *impetus*. But an inert body does nothing; so neither does a body moved.

27. In reality, a body equally persists in each state, either of rest or of motion. But its doing so can no more be called an

action of body, than its existence can be called its action. Its persevering is nothing more than a continuation in the same mode of existence, which cannot properly be called action. But the resistance which we experience in stopping a body in motion, we make out to be an action of it; but this is a delusion. For, in reality, that resistance which we perceive is an impression in ourselves; nor does it prove that body acts, but that we have an impression; and it is plain that we should have the same impression whether the body were moved by itself, or were impelled by some other principle.

28. Action and reaction are said to be in bodies; and such expressions are convenient for mechanical demonstrations. But we should be on our guard not therefore to suppose in them some real virtue which may be the cause or origin of motion. For those words are to be understood in the same way as the word attraction; and as this last is merely a mathematical hypothesis, and not a physical quality, the same should be understood concerning those, and for the same reason. For as truth, and the use of theorems concerning the mutual attraction of bodies remain unshaken in mechanical philosophy, as founded on the motion of bodies, whether that motion may be supposed by the action of bodies mutually attracting each other, or by the action of some agent different from body, impelling and stopping bodies; for the same reason, whatsoever things have been laid down concerning the rules and laws of motion, and the theorems deduced from them, remain unquestionable, provided the sensible effects and reasonings depending on them be admitted.

29. Let extension, solidity, figure, be taken away from the idea of body, nothing will remain; but these qualities are indifferent to motion, nor have they any thing in them which can be styled the origin. This is clear from our ideas themselves. If, therefore, by the word body be signified that which we conceive, it is quite clear that the origin of motion cannot be implied, for no part or attribute of it is a real, efficient cause, which can produce motion. But to use a word, and attach no idea to it, is in truth unworthy of a philosopher.

30. We find that there is a thinking, active being, which we learn, from experience, to be the origin of motion, in us. This we style soul, mind, spirit. We find that there is also a being extended, inert, moveable; which differs altogether from the other, and constitutes a new class. Anaxagoras, a man of great sagacity, who first perceived the difference between thinking and extended being, asserted that mind had nothing in common with body, as appears from the first book of Aristotle on the Mind. Among the moderns, Descartes also, has very well laid this down. Some, after him, have made this plain truth confused and difficult by their obscure expressions.

31. It is clear from what we have laid down, that those who affirm that active power, action, the origin of motion, are actually in body, maintain an opinion unsupported by experience; that they prop it up by obscure and general terms, nor do they completely understand themselves. They, on the contrary, who maintain that mind is the origin of motion, express an opinion supported by their own experience, and confirmed by the opinion of the most learned men in all ages.

32. Anaxagoras first had recourse to mind (τὸν νοῦν), as that which impressed motion on inert matter. Which opinion Aristotle also maintains and confirms by many arguments, justly asserting that the first mover is immoveable, indivisible, and has no magnitude. To say that every thing producing motion must be moveable, he rightly maintains, is as if a person would maintain that every thing which builds must be capable of being built, Physics, lib. viii. Plato also, in Timæus, lays it down, that this material machine, or the visible world, is moved and animated by a mind which evades all sensation. Still further, the Cartesians of the present day acknowledge God as the origin of motion. Newton, also, every where intimates, by no means obscurely, that motion not only originally proceeds from the Deity, but that still the mundane system is kept in motion by his power. This agrees with scripture, and is confirmed by the calculations of the learned. For although the Peripatetics lay it down that nature is the origin of motion and rest, they interpret it to be the Deity acting as motion. For they understand that all the bodies of this mundane system are moved by an all-powerful mind, according to a certain and constant reason.

33. But those who attribute a vital principle to bodies, devise something obscure and ill agreeing with reality. For what else is being endowed with vital principle than to live; or to live, than to move itself, stop, and change its state? Now the philosophers of the present day lay it down as an indisputable principle, that every body perseveres in its state, either of rest or of uniform rectilinear motion, unless so far as it is from some external cause compelled to change that state; on the contrary, in mind, we perceive a power of changing its own state, as well as that of other beings, which is called vital, and fully distinguishes mind from body.

34. The moderns consider motion and rest in bodies as two states of existence, in each of which every body naturally would remain inert, unless external force impelled it. Whence we may say that the cause of motion and rest is the same as that of the existence of body, for it does not seem that we should look out for any cause of the successive existence of body in different parts of space, than that whence results

the successive existence of body in different parts of time. But to treat of the God Almighty and All Good, the Creator and Preserver of all things, and in what manner all things depend on the supreme and true Being, although the most exalted branch of human learning, belongs rather to primary philosophy, or metaphysics and theology, than to natural philosophy, which at present is almost completely restricted to experiments and mechanics. Therefore natural philosophy either presupposes a knowledge of the Deity, or derives it from some science of a higher order. Although it is most true that the investigation of nature every where affords excellent arguments to the higher sciences, for illustrating and proving the wisdom, goodness, and power of God.

35. This not being sufficiently understood is the reason why some unadvisedly regret the mathematical principles of physics on that ground, that they do not assign efficient causes of things; when, in truth, it appertains to physics or mechanics to state the rules only of impulse and attraction, and not the efficient causes, in a word, the laws of motion; and from these, when received, to assign the solution of particular phenomena, but not their efficient cause.

36. It will be of great use to consider what origin properly is, and in what sense it must be taken amongst philosophers. Now the true, efficient, and preserving cause of all things is most properly called their source and origin. But the word *principia*, when applied to experimental philosophy, properly signifies the grounds on which it rests, or the sources from which is derived (I do not say the existence, but) the knowledge of material beings, these grounds being sensation and experience. In the same way, in mechanical philosophy, we mean by *principia* that constituting the grounds and extent of the whole science; being those primary laws of motion which, confirmed by experiment, are cultivated and rendered universal by reason. These laws of motion are appropriately called *principia*, principles, since from them are derived as well the general theorems of mechanics as the particular explanations of phenomena.

37. Then truly something can be said to be explained mechanically when it is reduced to those most simple and universal principles, and is by accurate reasoning shown to be suitable and connected with them. For the laws of nature being once ascertained, it remains for the philosopher to show that each thing necessarily follows in conformity with these laws; that is, that every phenomenon necessarily results from the principles. This is to explain and solve the phenomena; that is to assign the reason why they take place.

38. The human mind delights in extending and enlarging its knowledge. But for this purpose general notions and proposi-

tions must be formed, in which, in some way or other, are comprised particular propositions and facts; which are then considered to be understood when they are deduced from them by continued consequence. This is well known to geometricians. In mechanics, also, the course is, first, to lay down notions; that is, definitions and elementary and general positions concerning motion; from which subsequently, in the mathematical style, more remote and less general conclusions are drawn. And, as by the application of geometrical theorems the magnitudes of particular bodies are measured, so by the application of the general theorems of mechanics we ascertain and determine the motions of any parts of the mundane system, and the phenomena depending on them; and this the investigator of physics should exclusively aim at.

39. And as geometricians, for the sake of practice, devise many things which they neither themselves can contrive nor find in the nature of things, for the same reason those who treat of mechanics employ certain abstract and general words, and assume power, action, attraction, solicitation, &c.; which are of the first utility for theories, enunciations, and computations concerning motion, although in actual truth and bodies really they are sought in vain, as much as are those things imagined by mathematical abstraction.

40. In reality, by the use of our senses we perceive nothing except effects or sensible qualities, and material beings in all respects passive, whether at rest or in motion; and reason and experience indicate nothing active except mind or soul; whatever is imagined more than this must be regarded of the same sort as those mathematical hypotheses and abstractions; and we should thoroughly bear this in mind. Unless this take place we may easily relapse into the obscure subtlety of the schoolmen, which for so many ages infected philosophy like a dreadful plague.

41. The mechanical principles and universal laws of motion, or of nature, happily discovered in the last century, and treated of and applied by the aid of geometry, have thrown a wonderful light on philosophy. But the metaphysical principles, and the real efficient causes of motion, and of the existence of bodies, and the attributes of bodies, by no means belong to mechanics or experiments; nor can they throw light on them, except this far, that known previously, they may serve to define the limits of physics, and thus to do away with difficulties and questions which are foreign to them.

42. Those who derive the origin of motion from spirit, understand by the name either a corporeal or incorporeal being. If they understand a corporeal being, however subtle, the difficulty recurs; but if an incorporeal, however true may be their opinion,

it does not properly belong to physics. Wherefore, if any extend natural philosophy beyond the limits of experiments and mechanics, so that it embraces the knowledge of immaterial, unextended things, the wider extent of the word admits the treating of soul and mind, or the vital principle. But it will be more commodious, according to the usage now generally received, to distinguish between sciences; so that each be circumscribed by proper limits, and the natural philosopher be entirely engaged in experiments on the laws of motion, and in mechanical principles, and the reasonings deduced from them; but what he may bring forward concerning other things he should consider the offspring of a more exalted science. For from the knowledge of the laws of nature the most beautiful theories, as well as mechanical processes useful to life, proceed; but from knowledge concerning the Author of nature himself arise speculations unquestionably of the highest order, but metaphysical, moral, and theological.

43. So far concerning the principles, we must now treat of the nature, of motion. And it, indeed, since it is clearly perceived by the senses, has been obscured not so much by its own nature, as by the learned conjectures of philosophers. Motion never is presented to our senses without material mass, space, and time. There are some, however, who try to contemplate motion as a certain simple and abstract idea, and abstracted from all other things. But that very subtle and fine-drawn idea evades the acuteness of our intellects, as any one can experience by meditation. Hence result great difficulties concerning the nature of motion, and definitions more obscure than the thing which they are intended to explain. Such is that of Aristotle and the schoolmen, who say that motion is the act of what is moveable, as far as it is moveable; or the acting of a being in power as far as it is in power. Such is that also of a celebrated author of later times, who asserts that there is nothing real in motion except that momentary thing which ought to be comprised in power struggling for a change. Moreover, it is plain that the authors of these and of similar definitions have bent their minds on explaining the abstract nature of motion, laying aside all consideration of time and place; but how that abstract quintessence of motion, as I may call it, can be understood, I cannot perceive.

44. Nor are they content with this; but they go further, and separate and discriminate from each other the parts of motion, the distinct ideas of which they attempt to form, as of beings really distinct; for there are some who distinguish if motion from movement, regarding the former as the instantaneous element of movement. Still further; they regard velocity, effort, force, impetus, as many things differing essen-

tially, each of which is presented to the intellect by a peculiar idea, distinct and abstracted from all others. But if what we have before treated of be admitted, we need spend no more time in these discussions.

45. Many also define motion by means of transition, not recollecting that transition itself cannot be understood without motion, and ought to be defined by means of motion. So true is it, that definitions which throw light on some things, cause darkness in others. And, indeed, whatever we perceive by our senses, scarcely any one can make better known or more clear by definitions. Allured by the vain hope of which, philosophers have made the easiest things most difficult; and have entangled their minds in difficulties which they have themselves, for the most part, caused. From this desire of defining, as well as of abstracting, many questions at once both subtle and useless, which have arisen both concerning motion and other things, have fruitlessly racked men's minds; so that Aristotle freely, on many occasions, confesses that motion is some act difficult to be known; and some of the ancients became so hackneyed in these trifles that they altogether denied the existence of motion.

46. But it is grievous to be detained by trifles of this kind. Let it suffice to show the sources of the solutions, and to add, that all the paradoxes and thorny theories (such, for instance, as those which treat of infinites) which have been introduced into mathematics, concerning the unlimited division of time and space, have been introduced into the definitions concerning motion; but all things of that kind motion has in common with time and space, or rather refers to them.

47. Still further, as the too great division or abstraction of things in reality inseparable, so on the other hand the combination, or rather confusion, of things most different, has rendered the nature of motion perplexed. For it is usual to confound motion with the efficient cause of motion. Whence motion is as it were twofold; having one face obvious to our senses, the other wrapped in dark night. Hence result obscurity, confusion, and various paradoxes concerning motion. Whilst that is rashly attributed to effect, which in reality can belong only to cause.

48. Hence arises the opinion, that the same quantity of motion is always kept up, which any one must know to be false, unless it be understood concerning the force or power of the cause, whether that cause be termed nature or νοῦς, or whatever sort of agent it may be. Aristotle, in the eighth book of his Physics, where he inquires whether motion be created and corrupt, or be in all things from eternity as an immortal life, seems to have understood rather a vital principle, than an external effect or change of place.

49. Hence it is that many think that motion is not a merely passive quality of body. If this mean what is presented to our senses in the case of motion, no one can doubt that it is altogether passive; for what has the successive existence of body in various places that has any thing to do with action, or can be any thing but mere inert effect?

50. The Peripatetics, who maintain that motion is one act of two beings, of the mover and of the moved, do not sufficiently distinguish cause from effect. In the same way, those who imagine endeavour or effort in motion, or think that the same body is impelled towards different parts, seem to sport with the same confusion of ideas, the same ambiguity of words.

51. It is of great use, as in all other things, so in science, to investigate accurately about motion, as well for understanding the opinions of others, as for accurately enunciating our own; and unless there be some fault in this respect, I scarcely think that a dispute can be raised, whether body be indifferent to motion and rest, or not. For since it is clear from experience, that it is a primary law of nature that a body should persevere in a state of motion or of rest as long as nothing occurs from another quarter to change that state, and therefore it may be concluded that the inert quality is in different respects either resistance or impetus: in this sense certainly body can be said to be indifferent as to rest or motion. For it is as difficult to cause rest in a moving body, as to cause motion in a body at rest; but when a body equally preserves either state, why should it not be said to be indifferently circumstanced as to both?

52. But the Peripatetics, according to the variety of the changes which any body can undergo, distinguished various kinds of motion. Those who at present treat the subject take into account only local motion. But local motion cannot be understood, unless we also understand the meaning of *place*, which is by the moderns defined to be the part of space which body occupies, and therefore in reference to space it is divided into absolute and relative. For they distinguish between absolute and true space, and that which is apparent or relative. They maintain indeed that there exists in every direction an immense immoveable space, not the object of sensation, but pervading and embracing all bodies, and this they call absolute space. But the space comprehended or marked out by body, and so subjected to our senses, is called relative, apparent, common space.

53. Let us then imagine all bodies to be destroyed and annihilated. What then remains they call absolute space, all relation resulting from the situation and distances of bodies, as well as the bodies themselves, being done away with. Now this space

is infinite, immoveable, indivisible, not the object of sensation, without relation and without distinction. That is, all its attributes are privative or negative; therefore it seems to be a mere nothing. The only difficulty results from its being extended, for extension is a positive quality. But what sort of extension is that, which can be neither divided nor measured, no part of which we can either perceive by our senses, or figure in the imagination? for nothing can enter the imagination which from the nature of the thing is not possible to be perceived by sensation, since imagination is nothing else than a faculty representing the objects of sensation, either existing in act, or at least being possible. It also evades pure intellect, since that faculty is only conversant about spiritual and unextended things, such as our minds, their habits, passions, virtues, and such things. Let us, then, take away mere words from absolute space, and nothing remains in sensation, imagination, or intellect; nothing, therefore, is denoted by them but mere privation or negation, that is, mere nothing.

54. It must be allowed, that with respect to this subject, we are entangled with the greatest prejudices, to free ourselves from which we must exert the whole vigour of our minds; for many are so far from considering absolute space as a non-entity, that they think it the only thing, except God, which cannot be annihilated; and maintain that it necessarily exists by its own nature, and is eternal and uncreated, and consequently participates in the divine attributes. But since it is most certain that every thing which we denote by names is in some respect known by qualities and relations (for it would be silly to make use of words having no known thing, no notion, no idea or conception attached), let us diligently inquire whether we can form any idea of that pure, real, absolute space, which would continue to exist after the annihilation of all body. Examining such an idea accurately, I find it to be the most perfect idea of nothing, if it can be called an idea. This has been the case with me after I have used all my diligence; and I think that others will find the same if they use the same diligence.

55. It sometimes is wont to lead us astray, that all other bodies being in imagination done away with, we suppose that our own bodies remain; and supposing this, we imagine the freest motion of our limbs in every direction. But motion cannot be conceived without space. Still if we consider the matter more attentively, it is clear, 1st, that we conceive relative space marked out by the parts of our body; 2nd, a free power of moving our limbs, checked by nothing, and nothing besides this. However, we erroneously suppose that some other thing, called infinite space, really exists, which allows us free power of moving our bodies; for nothing more than the absence of other

bodies is required for this. Which absence or privation of body we must allow to be nothing positive.*

56. But unless these things be freely and closely examined, words and sounds are but of little avail. Now it will be clear to any one attentively considering, that whatever is predicated of pure space may be predicated of nothing. By which means the human mind is easily freed from great difficulties; and, at the same time, of attributing necessary existence to any being except the almighty and all-good God alone.

57. It were easy to confirm our opinion by arguments derived *à posteriori*, as it is called, by proposing questions concerning absolute space for instance, whether it be a substance or an accident, whether created or uncreated, and pointing out the absurdities resulting from either position. But I must be brief. It, however, ought not to be omitted, that Democritus formerly confirmed this opinion by his support, as Aristotle mentions in Physics, lib. i., where he has this passage, "Democritus lays down as principles, solidity and void, of which he says, that the one is as that which is, the other is as that which is not. But if any one would raise a doubt, that the distinction between absolute and relative space is admitted by great philosophers, and that many famous theorems are founded on that ground, it will appear from what follows, that such a ground is vain.

58. From what has been laid down, it is plain that it is not consistent that we should define the true place of a body to be that part of absolute space which the body occupies, and true or absolute motion to be the change of true and absolute place; since all place is relative, as well as all motion. But that this may appear more clearly it should be observed, that no motion can be understood without some direction or determination, which, indeed, cannot be understood unless, besides the body that is moved, our bodies also, or some other thing, be understood to exist: for upwards, downwards, to the left, to the right, and all places and regions, are founded in something relative, and necessarily imply some body distinct from that which is moved; so that if all other bodies were annihilated, and only one, a globe for instance, were supposed to exist, no motion could be conceived in it: so necessary is it that some body be given, by the situation of which motion can be determined. The truth of that opinion will most clearly appear, if we form a clear notion of the annihilation of all bodies, as well our own as others, except that globe.

59. Moreover, let there be two globes imagined, and nothing corporeal besides. Let it then be imagined that forces are in some way applied: whatsoever we may understand by the appli-

* See what has been urged against absolute space in the book concerning the Principles of Human Knowledge. Vol. I. p. 131.

cation of forces, a circular motion of the two globes about a common centre cannot be conceived in imagination. Let us suppose then, the heavens of fixed stars to be created immediately; motion will be conceived from the conceived course of the globes to different parts of that heaven. For since motion is in its nature relative, it cannot be conceived before that correlative bodies be given, as also no other relation can be conceived without correlatives.

60. As to circular motion, many think that true circular motion increasing, a body tends more and more to recede from the axis. But this results from that circumstance, because, since circular motion can be regarded as every moment resulting from two directions, one that of the radius, the other that of the tangent, if the force be increased in this last direction, then the body in motion will recede from the centre, but the orbit will cease to be circular. But if the forces be equally increased in both directions, the circular motion will continue, but accelerated; which will prove that the forces, both of receding from the axis and of approaching it, are increased. It must therefore be said that water, whirled round in a bucket, mounts up the side of the vessel, because, fresh forces being applied to each particle of water in the direction of the tangent in the same instant, fresh centripetal forces are not applied. From which experiment it by no means follows, that the absolute circular motion is necessarily indicated by the forces of the motion receding from the axis. Moreover, how we should understand the words forces and efforts of bodies appears plainly from what has been already written.

61. In the same way as a curve may be considered as consisting of an infinite number of right lines, although not in reality consisting of them, but because the hypothesis is serviceable for geometry, so a circular motion may be regarded as resulting from an infinity of rectilineal directions, an hypothesis useful in mechanical philosophy. It is not, however, to be maintained, that it is impossible that the centre of gravity of each body may successively exist in each point of the periphery of a circle, no account being taken of any rectilineal direction, either in the tangent or in the radius.

62. It should not be omitted, that the motion of a stone in a sling, or of water whirled round in a bucket, cannot be called a really circular motion, according to the notion of those who define the true limits of body by the parts of absolute space, since it is wonderfully compounded of the motions, not only of the sling or bucket, but of the diurnal motion of the earth round its axis, its monthly motion round the common centre of gravity of the earth and moon, and its annual round the sun; on account of which every particle of the stone or water describes a line

very widely differing from a circular one. Neither, in reality, is that, as it is supposed, an axifugal tendency, since it does not regard any one axis with reference to absolute space, if the existence of absolute space be admitted; so I do not see how it can be called a single tendency, to which a motion, truly circular, corresponds as to its proper and adequate effect.

63. No motion can be perceived or measured except by what is the object of sensation. Since, therefore, absolute space is not obvious to our senses, it must be of no avail for distinguishing. Besides, determination or direction is essential to motion; but that consists in relation; therefore it is impossible to conceive absolute motion.

64. Moreover, since according to the difference of relative place, the motion of the same body may be various, and indeed a body may be said to be moved in one respect, and motionless in another; for determining true motion and true rest, for the purpose of removing ambiguity and advancing the mechanical philosophy of those who contemplate the system of things in a more enlarged way, it will be sufficient, instead of absolute space, to regard relative space as marked out by the heavens of the fixed stars considered as at rest. But motion and rest, marked out by such relative space, can be conveniently used instead of the absolute, which can by no distinction be discriminated from them. For howsoever forces may be impressed, whatever tendencies there may be, let us admit that motion is distinguished by means of action on bodies, it will, however, never follow from thence, that there are absolute space and place, and that its change is the true place.

65. The laws and effects of motion, and theorems containing their proportions and calculations, according to their different courses, also their accelerations and different directions, and mediums of more or less resistance; all these come out without the calculation of absolute motion. As is plain from this, that according to the principles of those who bring forward absolute motion, it cannot be known by any symptom, whether the whole frame of things rests or is moved uniformly in direction; it is clear that the absolute motion of no body can be known.

66. From what has been said, it appears, that to ascertain the true nature of motion, it will be of great avail, 1st, to distinguish between mathematical hypotheses, and the nature of things; 2nd, to beware of abstractions; 3rd, to consider motion as something, the object of sensation, or at least of imagination; and to be content with relative measures: which if we do, at the same time the finest theorems of mechanical philosophy, by means of which the recesses of nature are disclosed, and the system of the world subjected to human calculation, will remain uninjured, and the consideration of motion freed from a thousand minute sub-

tleties and abstractions. And let it suffice to say so much concerning the nature of motion.

67. It remains that we should treat of the cause of the communication of motion. But most consider, that force impressed on a moveable body is the cause of motion in it. Nevertheless it results from what has been laid down, that they do not assign a known cause of motion, and distinct from body and motion. It is further clear, that force is not a thing certain and determinate, from the circumstance, that men of the greatest powers of mind advance different, and even contrary things, though retaining truth in the consequences. For Newton says, that force impressed consists in action alone, and is an action exercised on body to change its state, nor that it continues after. Torricelli contends that a certain accumulation or aggregation of forces impressed by percussion, is received into the moved body and remains there, and constitutes the impetus; Borelli and some others maintain the same. But although Newton and Torricelli seem to differ, each advancing things consistent with themselves, the matter is well enough explained by both. For forces attributed to bodies are as much mathematical hypotheses as attractive powers assigned to the planets and sun. Mathematical things, however, have no stable essence in nature, but depend on the notion of the definer, whence the same thing can be differently explained.

68. Let us lay it down, that the new motion is preserved in the struck body, either by innate force, by which any body continues in its state of motion or rest, uniformly in direction; or by force impressed, and during the impression received into the struck body, and there remaining; it will be the same as to reality, the difference existing only in name. In like manner, when the striking body loses, and the struck acquires motion, it is little to the purpose to dispute whether the motion acquired be numerically the same with that lost; for it leads us into metaphysical and verbal disputes concerning identity; therefore, whether we say that motion passes from the striking body into the struck, or that motion is generated anew in the struck body and destroyed in the striking, it amounts to the same thing. In each instance it is meant that one body acquires motion and another loses it, and nothing more.

69. That the intelligence which moves and embraces this whole corporeal mass, and is the efficient cause of motion, is strictly and properly speaking the cause of the communication of the same, I will not deny. However, in physical philosophy we ought to deduce the causes and solutions of phenomena from mechanical principles. The thing is explained physically, not by assigning the really acting and immaterial cause, but by demonstrating its connexion with mechanical principles. Of that kind is that, that

action and reaction are always contrary and equal, from which, as from a primary principle and source, are deduced the rules concerning the communication of motion, which have been ascertained and demonstrated by moderns to the great benefit of science.

70. Let it suffice us to hint that that principle can be declared in another way. For if the true nature of things, rather than abstract mathematics, be regarded, it will seem to be more properly said, that in attraction or percussion, the passive rather than the active quality of bodies is equal. For instance, a stone tied by a rope to a horse is as much drawn towards the horse as the horse towards the stone. A moved body also dashed against another at rest suffers the same change with the quiescent body, and as to the real effect the striking body is also struck, the struck body striking. But the change in each instance, as well in the body of the horse as in the stone, in the body in motion and at rest, is a merely passive state. But it does not appear that there is a force, a virtue, or material action, really and properly causing such effects. A body in motion is dashed against one at rest; but we use an active mode of expression, saying, that the one impels the other, and not improperly in mechanics, where the mathematical rather than the actual causes of things are considered.

71. In physics, sensation and experience, which only reach apparent effects, are admitted; in mechanics, the abstract notions of mathematicians are admitted. In primary philosophy, or metaphysics, we treat of immaterial things, causes, truth, and the existence of things. The writer on physics contemplates the series or succession of the objects of sense, by what laws they are connected, and in what order; observing what precedes as a cause, what follows as an effect. And in this way we say that a moved body is the cause of motion in another, or impresses motion on it; also that it draws or impels. In which sense secondary corporeal causes ought to be understood, no account being taken of the actual place of the forces, or active powers, or of the real cause in which they are. Moreover, beyond body, figure, motion, the primary axioms of mechanical science can be styled cause, or mechanical principles, being regarded as the causes of what follow them.

72. The truly active causes can be extracted only by meditation and reasoning from the shades in which they are involved, and thus at all become known. But it is the province of primary philosophy, or of metaphysics, to treat of them. Wherefore if its own province were assigned to each science, its limits marked out, its principles and objects accurately distinguished, we could treat of what belongs to each with greater facility and perspicuity.

THE ANALYST:

OR

A DISCOURSE ADDRESSED TO AN INFIDEL MATHEMATICIAN:

WHEREIN IT IS EXAMINED

WHETHER THE OBJECT, PRINCIPLES, AND INFERENCES OF THE MODERN ANALYSIS ARE MORE DISTINCTLY CONCEIVED, OR MORE EVIDENTLY DEDUCED, THAN RELIGIOUS MYSTERIES AND POINTS OF FAITH.

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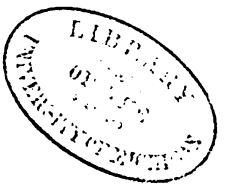


THE ANALYST.

I. THOUGH I am a stranger to your person, yet I am not, Sir, a stranger to the reputation you have acquired in that branch of learning which hath been your peculiar study; nor to the authority that you therefore assume in things foreign to your profession; nor to the abuse that you, and too many more of the like character, are known to make of such undue authority, to the misleading of unwary persons in matters of the highest concernment, and whereof your mathematical knowledge can by no means qualify you to be a competent judge. Equity indeed and good sense would incline one to disregard the judgment of men, in points which they have not considered or examined. But several who make the loudest claim to those qualities do nevertheless the very thing they would seem to despise, clothing themselves in the livery of other men's opinions, and putting on a general deference for the judgment of you, gentlemen, who are presumed to be of all men the greatest masters of reason, to be most conversant about distinct ideas, and never to take things upon trust, but always clearly to see your way, as men whose constant employment is the deducing truth by the justest inference from the most evident principles. With this bias on their minds, they submit to your decisions where you have no right to decide. And that this is one short way of making infidels, I am credibly informed.

II. Whereas then it is supposed, that you apprehend more distinctly, consider more closely, infer more justly, conclude more accurately than other men, and that you are therefore less religious because more judicious, I shall claim the privilege of a free-thinker; and take the liberty to inquire into the object, principles, and method of demonstration admitted by the mathematicians of the present age, with the same freedom that you presume to treat the principles and mysteries of religion; to the end that all men may see what right you have to lead, or what encouragement others have to follow you. It hath been an old remark, that geometry is an excellent logic. And it must be owned, that when the definitions are clear; when the postulata cannot be refused, nor the axioms denied; when from the dis-

tinct contemplation and comparison of figures, their properties are derived, by a perpetual well-connected chain of consequences, the objects being still kept in view, and the attention ever fixed upon them; there is acquired a habit of reasoning, close and exact and methodical: which habit strengthens and sharpens the mind, and being transferred to other subjects, is of general use in the inquiry after truth. But how far this is the case of our geometrical analysts, it may be worth while to consider.

III. The method of fluxions is the general key, by help whereof the modern mathematicians unlock the secrets of geometry, and consequently of nature. And as it is that which hath enabled them so remarkably to outgo the ancients in discovering theorems and solving problems, the exercise and application thereof is become the main, if not sole, employment of all those who in this age pass for profound geometers. But whether this method be clear or obscure, consistent or repugnant, demonstrative or precarious, as I shall inquire with the utmost impartiality, so I submit my inquiry to your own judgment, and that of every candid reader. Lines are supposed to be generated* by the motion of points, planes by the motion of lines, and solids by the motion of planes. And whereas quantities generated in equal times are greater or lesser according to the greater or lesser velocity wherewith they increase and are generated, a method hath been found to determine quantities from the velocities of their generating motions. And such velocities are called fluxions: and the quantities generated are called flowing quantities. These fluxions are said to be nearly as the increments of the flowing quantities, generated in the least equal particles of time; and to be accurately in the first proportion of the nascent, or in the last of the evanescent increments. Sometimes, instead of velocities, the momentaneous increments or decrements of undetermined flowing quantities are considered, under the appellation of moments.

IV. By moments we are not to understand finite particles. These are said not to be moments, but quantities generated from moments, which last are only the nascent principles of finite quantities. It is said, that the minutest errors are not to be neglected in mathematics: that the fluxions are celerities, not proportional to the finite increments though ever so small; but only to the moments of nascent increments, whereof the proportion alone, and not the magnitude, is considered. And of the aforesaid fluxions there be other fluxions, which fluxions of fluxions are called second fluxions. And the fluxions of these second fluxions are called third fluxions: and so on, fourth, fifth, sixth, &c., *ad infinitum*. Now as our sense is strained and puzzled with the perception of objects extremely minute, even so

* Introd. ad Quadraturam Curvarum.

the imagination, which faculty derives from sense, is very much strained and puzzled to frame clear ideas of the least particles of time, or the least increments generated therein: and much more so to comprehend the moments, or those increments of the flowing quantities in *statu nascenti*, in their very first origin or beginning to exist, before they become finite particles. And it seems still more difficult to conceive the abstracted velocities of such nascent, imperfect entities. But the velocities of the velocities, the second, third, fourth, and fifth velocities, &c., exceed, if I mistake not, all human understanding. The further the mind analyzeth and pursueth these fugitive ideas, the more it is lost and bewildered; the objects, at first fleeting and minute, soon vanishing out of sight. Certainly, in any sense, a second or third fluxion seems an obscure mystery. The incipient celerity of an incipient celerity, the nascent augment of a nascent augment, i. e. of a thing which hath no magnitude; take it in what light you please, the clear conception of it will, if I mistake not, be found impossible: whether it be so or no, I appeal to the trial of every thinking reader. And if a second fluxion be inconceivable, what are we to think of third, fourth, fifth fluxions, and so onward without end?

V. The foreign mathematicians are supposed by some, even of our own, to proceed in a manner less accurate perhaps and geometrical, yet more intelligible. Instead of flowing quantities and their fluxions, they consider the variable finite quantities, as increasing or diminishing by the continual addition or subduction of infinitely small quantities. Instead of the velocities wherewith increments are generated, they consider the increments or decrements themselves, which they call differences, and which are supposed to be infinitely small. The difference of a line is an infinitely little line; of a plane, an infinitely little plane. They suppose finite quantities to consist of parts infinitely little, and curves to be polygons, whereof the sides are infinitely little, which by the angles they make one with another determine the curvity of the line. Now to conceive a quantity infinitely small, that is, infinitely less than any sensible or imaginable quantity, or any the least finite magnitude, is, I confess, above my capacity. But to conceive a part of such infinitely small quantity, that shall be still infinitely less than it, and consequently though multiplied infinitely, shall never equal the minutest finite quantity, is, I suspect, an infinite difficulty to any man whatsoever; and will be allowed such by those who candidly say what they think; provided they really think and reflect, and do not take things upon trust.

VI. And yet in the *calculus differentialis*, which method serves to all the same intents and ends with that of fluxions, our modern analysts are not content to consider only the differences of finite quantities: they also consider the differences of those differences, and the differences of the differences of the first differences; and

so on *ad infinitum*. That is, they consider quantities infinitely less than the least discernible quantity; and others infinitely less than those infinitely small ones; and still others infinitely less than the preceding infinitesimals, and so on without end or limit. Insomuch that we are to admit an infinite succession of infinitesimals, each infinitely less than the foregoing, and infinitely greater than the following. As there are first, second, third, fourth, fifth, &c., fluxions, so there are differences, first, second, third, fourth, &c., in an infinite progression towards nothing, which you still approach and never arrive at. And, which is most strange, although you should take a million of millions of these infinitesimals, each whereof is supposed infinitely greater than some other real magnitude, and add them to the least given quantity, it shall be never the bigger. For this is one of the modest *postulata* of our modern mathematicians, and is a cornerstone or groundwork of their speculations.

VII. All these points, I say, are supposed and believed by certain rigorous exactors of evidence in religion, men who pretend to believe no further than they can see. That men who have been conversant only about clear points should with difficulty admit obscure ones, might not seem altogether unaccountable. But he who can digest a second or third fluxion, a second or third difference, need not, methinks, be squeamish about any point in divinity. There is a natural presumption that men's faculties are made alike. It is on this supposition that they attempt to argue and convince one another. What, therefore, shall appear evidently impossible and repugnant to one may be presumed the same to another. But with what appearance of reason shall any man presume to say, that mysteries may not be objects of faith, at the same time that he himself admits such obscure mysteries to be the object of science?

VIII. It must indeed be acknowledged, the modern mathematicians do not consider these points as mysteries, but as clearly conceived and mastered by their comprehensive minds. They scruple not to say, that, by the help of these new analytics they can penetrate into infinity itself: that they can even extend their views beyond infinity: that their art comprehends not only infinite, but infinite of infinite (as they express it), or an infinity of infinites. But, notwithstanding all these assertions and pretensions, it may be justly questioned whether, as other men in other inquiries are often deceived by words or terms, so they likewise are not wonderfully deceived and deluded by their own peculiar signs, symbols, or species. Nothing is easier than to devise expressions or notations for fluxions and infinitesimals of the first, second, third, fourth, and subsequent orders, proceeding in the same regular form without end or limit, $\dot{x}$. $\ddot{x}$. $\dddot{x}$. $\ddddot{x}$. &c., or *dx*. *ddx*. *dddx*. *ddddx*.

&c. These expressions indeed are clear and distinct, and the mind finds no difficulty in conceiving them to be continued beyond any assignable bounds. But if we remove the veil and look underneath, if laying aside the expressions we set ourselves attentively to consider the things themselves, which are supposed to be expressed or marked thereby, we shall discover much emptiness, darkness, and confusion; nay, if I mistake not, direct impossibilities and contradictions. Whether this be the case or no, every thinking reader is entreated to examine and judge for himself.

IX. Having considered the object, I proceed to consider the principles of this new analysis by momentums, fluxions, or infinitesimals; wherein if it shall appear that your capital points, upon which the rest are supposed to depend, include error and false reasoning; it will then follow that you, who are at a loss to conduct yourselves, cannot with any decency set up for guides to other men. The main point in the method of fluxions is to obtain the fluxion or momentum of the rectangle or product of two indeterminate quantities. Inasmuch as from thence are derived rules for obtaining the fluxions of all other products and powers, be the co-efficients or the indexes what they will, integers or fractions, rational or surd. Now this fundamental point, one would think, should be very clearly made out, considering how much is built upon it, and that its influence extends throughout the whole analysis. But let the reader judge. This is given for demonstration.* Suppose the product or rectangle A B increased by continual motion: and that the momentaneous increments of the sides A and B are a and b. When the sides A and B were deficient, or lesser by one-half of their moments, the rectangle was $\overline{\mathrm{A} - \frac{1}{2}a} \times \overline{\mathrm{B} - \frac{1}{2}b}$, i. e. $\mathrm{AB} - \frac{1}{2}a\,\mathrm{B} - \frac{1}{2}b\mathrm{A} + \frac{1}{4}ab$. And as soon as the sides A and B are increased by the other two halves of their moments, the rectangle becomes $\overline{\mathrm{A}+\frac{1}{2}a} \times \overline{\mathrm{B}+\frac{1}{2}b}$ or $\mathrm{AB} + \frac{1}{2}a\mathrm{B} + \frac{1}{2}b\mathrm{A} + \frac{1}{4}ab$. From the latter rectangle subduct the former, and the remaining difference will be $a\mathrm{B} + b\mathrm{A}$. Therefore the increment of the rectangle generated by the entire increments a and b is $a\mathrm{B} + b\mathrm{A}$. Q. E. D. But it is plain that the direct and true method to obtain the moment or increment of the rectangle AB, is to take the sides as increased by their whole increments, and so multiply them together, $\mathrm{A}+a$ by $\mathrm{B}+b$, the product whereof $\mathrm{AB} + a\mathrm{B} + b\mathrm{A} + ab$ is the augmented rectangle; whence if we subduct AB, the remainder $a\mathrm{B} + b\mathrm{A} + ab$ will be the true increment of the rectangle, exceeding that which was obtained by the former illegitimate and indirect method by the quantity ab. And this holds universally by the quantities a and b, be what they will, big or little, finite or infinitesimal, increments, moments, or velocities. Nor will it avail to say that $a\,b$

* Naturalis Philosophiæ Principia Mathematica, lib. ii. lem. 2.

is a quantity exceeding small: since we are told that *in rebus mathematicis errores quam minimi non sunt contemnendi.*

X. *Such reasoning as this for demonstration, nothing but the obscurity of the subject could have encouraged or induced the great author of the fluxionary method to put upon his followers, and nothing but an implicit deference to authority could move them to admit. The case indeed is difficult. There can be nothing done till you have got rid of the quantity *ab*. In order to this the notion of fluxions is shifted: it is placed in various lights: points which should be clear as first principles are puzzled; and terms which should be steadily used are ambiguous. But notwithstanding all this address and skill the point of getting rid of *a b* cannot be obtained by legitimate reasoning. If a man by methods not geometrical or demonstrative, shall have satisfied himself of the usefulness of certain rules; which he afterwards shall propose to his disciples for undoubted truths; which he undertakes to demonstrate in a subtile manner, and by the help of nice and intricate notions; it is not hard to conceive that such his disciples may, to save themselves the trouble of thinking, be inclined to confound the usefulness of a rule with the certainty of a truth, and accept the one for the other; especially if they are men accustomed rather to compute than to think; earnest rather to go on fast and far than solicitous to set out warily and see their way distinctly.

XI. The points or mere limits of nascent lines are undoubtedly equal, as having no more magnitude one than another, a limit, as such, being no quantity. If by a momentum you mean more than the initial limit, it must be either a finite quantity or an infinitesimal. But all finite quantities are expressly excluded from the notion of a momentum. Therefore the momentum must be an infinitesimal. And indeed, though much artifice hath been employed to escape or avoid the admission of quantities infinitely small, yet it seems ineffectual. For aught I see, you can admit no quantity as a medium between a finite quantity and nothing, without admitting infinitesimals. An increment generated in a finite particle of time is itself a finite particle; and cannot therefore be a momentum. You must therefore take an infinitesimal part of time wherein to generate your momentum. It is said, the magnitude of moments is not considered. And yet these same moments are supposed to be divided into parts. This is not easy to conceive, nor more than it is why we should take quantities less than A and B in order to obtain the increment of A B, of which proceeding it must be owned the final cause or motive is obvious; but it is not so obvious or easy to explain a just and legitimate reason for it, or show it to be geometrical.

XII. From the foregoing principle so demonstrated, the gene-

* Introd. ad Quadraturam Curvarum.

ral rule for finding the fluxion of any power of a flowing quantity is derived.* But as there seems to have been some inward scruple or consciousness of defect in the foregoing demonstration, and as this finding the fluxion of a given power is a point of primary importance, it hath therefore been judged proper to demonstrate the same in a different manner independent of the foregoing demonstration. But whether this other method be more legitimate and conclusive than the former, I proceed now to examine; and in order thereto shall premise the following lemma. "If with a view to demonstrate any proposition a certain point is supposed, by virtue of which certain other points are attained; and such supposed point be itself afterwards destroyed or rejected by a contrary supposition; in that case all the other points attained thereby and consequent thereupon, must also be destroyed and rejected, so as from thenceforward to be no more supposed or applied in the demonstration." This is so plain as to need no proof.

XIII. Now the other method of obtaining a rule to find the fluxion of any power is as follows. Let the quantity x flow uniformly, and be it proposed to find the fluxion of x^n. In the same time that x by flowing becomes $x+o$, the power x^n becomes $\overline{x+o}\,|^n$, i. e. by the method of infinite series $x^n + n\,o\,x^{n-1} + \frac{nn-n}{2}\,o\,o\,x^{n-2} +$ &c., and the increments o and $n\,o\,x^{n-1} + \frac{nn-n}{2}\,o\,o\,x^{n-2} +$ &c., are one to another as 1 to $n\,x^{n-1} + \frac{nn-n}{2}\,o\,x +$ &c. Let now the increments vanish, and their last proportion will be 1 to $n\,x^{n-1}$. But it should seem that this reasoning is not fair or conclusive. For when it is said, let the increments vanish, i. e. let the increments be nothing or let there be no increments, the former supposition that the increments were something, or that there were increments, is destroyed, and yet a consequence of that supposition, i. e. an expression got by virtue thereof, is retained. Which, by the foregoing lemma, is a false way of reasoning. Certainly when we suppose the increments to vanish, we must suppose their proportions, their expressions, and every thing else derived from the supposition of their existence, to vanish with them.

XIV. To make this point plainer, I shall unfold the reasoning, and propose it in a fuller light to your view. It amounts therefore to this, or may in other words be thus expressed. I suppose that the quantity x flows, and by flowing is increased, and its increment I call o, so that by flowing it become $x+o$.

* Philosophiæ Naturalis Principia Mathematica, lib. ii. lem. 2.

And as x increaseth, it follows that every power of x is likewise increased in a due proportion. Therefore as x becomes $x + o$, x will become $\overline{x+o}\,|^n$: that is, according to the method of infinite series, $x^n + n\,o\,x^{n-1} + \frac{nn-n}{2}o\,o\,x^{n-2}$ + &c. And if from the two augmented quantities we subduct the root and the power respectively, we shall have remaining the two increments, to wit, o and $n\,o\,x^{n-1} + \frac{nn-n}{2}o\,o\,x^{n-2}$ + &c., which increments, being both divided by the common divisor o, yield the quotients 1 and $nx^{n-1} + \frac{nn-n}{2}o\,x^{n-2}$ + &c., which are therefore exponents of the ratio of the increments. Hitherto I have supposed that x flows, that x hath a real increment, that o is something. And I have proceeded all along on that supposition, without which I should not have been able to have made so much as one single step. From that supposition it is that I get at the increment of x^n, that I am able to compare it with the increment of x, and that I find the proportion between the two increments. I now beg leave to make a new supposition contrary to the first, i. e. I will suppose that there is no increment of x, or that o is nothing; which second supposition destroys my first, and is inconsistent with it, and therefore with every thing that supposeth it. I do nevertheless beg leave to retain $n\,x^{n-1}$, which is an expression obtained in virtue of my own supposition, which necessarily presupposed such supposition, and which could not be obtained without it. All which seems a most inconsistent way of arguing, and such as would not be allowed of in divinity.

XV. Nothing is plainer than that no just conclusion can be directly drawn from two inconsistent suppositions. You may indeed suppose any thing possible; but afterwards you may not suppose any thing that destroys what you first supposed. Or if you do, you must begin *de novo*. If, therefore, you suppose that the augments vanish, i. e. that there are no augments, you are to begin again, and see what follows from such supposition. But nothing will follow to your purpose. You cannot by that means ever arrive at your conclusion, or succeed in, what is called by the celebrated author, the investigation of the first or last proportions of nascent and evanescent quantities, by instituting the analysis in finite ones. I repeat it again: you are at liberty to make any possible supposition: and you may destroy one supposition by another: but then you may not retain the consequences, or any part of the consequences, of your first supposition so destroyed. I admit that signs may be made to denote either any thing or nothing: and, consequently, that in the original notation $x + o$, o might have signified either an incre-

ment or nothing. But then which of these soever you make it signify, you must argue consistently with such its signification, and not proceed upon a double meaning: which to do were a manifest sophism. Whether you argue in symbols or in words, the rules of right reason are still the same. Nor can it be supposed, you will plead a privilege in mathematics to be exempt from them.

XVI. If you assume at first a quantity increased by nothing, and in the expression $x + o$, o stands for nothing, upon this supposition as there is no increment of the root, so there will be no increment of the power; and, consequently, there will be none except the first, of all those members of the series constituting the power of the binomial; and will therefore never come to your expression of a fluxion legitimately by such method. Hence you are driven into the fallacious way of proceeding to a certain point on the supposition of an increment, and then at once shifting your supposition to that of no increment. There may seem great skill in doing this at a certain point or period. Since, if this second supposition had been made before the common division by o, all had vanished at once, and you must have got nothing by your supposition. Whereas, by this artifice of first dividing, and then changing your supposition, you retain 1 and $n\,x^n - 1$. But notwithstanding all this address to cover it, the fallacy is still the same. For whether it be done sooner or later, when once the second supposition or assumption is made, in the same instant the former assumption, and all that you got by it, is destroyed, and goes out together. And this is universally true, be the subject what it will, throughout all the branches of human knowledge; in any other of which, I believe men would hardly admit such a reasoning as this, which, in mathematics, is accepted for demonstration.

XVII. It may not be amiss to observe, that the method for finding the fluxion of a rectangle of two flowing quantities, as it is set forth in the Treatise of Quadratures, differs from the above-mentioned taken from the second book of the Principles, and is, in effect, the same with that used in the *Calculus Differentialis*.* For the supposing a quantity infinitely diminished, and therefore rejecting it, is, in effect, the rejecting an infinitesimal; and, indeed, it requires a marvellous sharpness of discernment, to be able to distinguish between evanescent increments and infinitesimal differences. It may, perhaps, be said, that the quantity being infinitely diminished becomes nothing, and so nothing is rejected. But according to the received principles it is evident, that no geometrical quantity can, by any division or subdivision whatsoever, be exhausted or reduced to nothing.

* Analyse des Infiniments Petits, part i. prop. 2.

Considering the various arts and devices used by the great author of the fluxionary method, in how many lights he placeth his fluxions, and in what different ways he attempts to demonstrate the same point; one would be inclined to think, he was himself suspicious of the justness of his own demonstrations, and that he was not enough pleased with any one notion steadily to adhere to it. Thus much at least is plain, that he owned himself satisfied concerning certain points, which nevertheless he would not undertake to demonstrate to others.* Whether this satisfaction arose from tentative methods or inductions, which have often been admitted by mathematicians (for instance by Dr. Wallis, in his Arithmetic of Infinites), is what I shall not pretend to determine. But whatever the case might have been with respect to the author, it appears that his followers have shown themselves more eager in applying his method, than accurate in examining his principles.

XVIII. It is curious to observe, what subtlety and skill this great genius employs to struggle with an insuperable difficulty; and through what labyrinths he endeavours to escape the doctrine of infinitesimals; which, as it intrudes upon him whether he will or no, so it is admitted and embraced by others without the least repugnance; Leibnitz and his followers, in their *calculus differentialis*, making no manner of scruple, first to suppose, and secondly to reject, quantities infinitely small: with what clearness in the apprehension, and justness in the reasoning, any thinking man, who is not prejudiced in favour of those things, may easily discern. The notion or idea of an infinitesimal quantity, as it is an object simply apprehended by the mind, hath been already considered.† I shall now only observe, as to the method of getting rid of such quantities, that it is done without the least ceremony. As in fluxions, the point of first importance, and which paves the way to the rest, is to find the fluxion of a product of two indeterminate quantities, so in the *calculus differentialis* (which method is supposed to have been borrowed from the former with some small alterations), the main point is to obtain the difference of such product. Now the rule for this is got by rejecting the product or rectangle of the differences. And in general it is supposed, that no quantity is bigger or lesser for the addition or subduction of its infinitesimal; and, consequently, no error can arise from such rejection of infinitesimals.

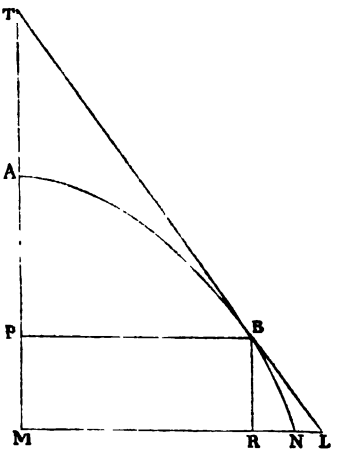
XIX. And yet it should seem that, whatever errors are admitted in the premises, proportional errors ought to be apprehended in the conclusion, be they finite or infinitesimal: and therefore the ἀκριβεία of geometry requires nothing should be

* See Letter to Collins, Nov 9, 1679. † Sect. v. and vi.

neglected or rejected. In answer to this you will perhaps say, that the conclusions are accurately true, and that therefore the principles and methods from whence they are derived must be so too. But this inverted way of demonstrating your principles by your conclusions, as it would be peculiar to you gentlemen, so it is contrary to the rules of logic. The truth of the conclusion will not prove either the form or the matter of a syllogism to be true; inasmuch as the illation might have been wrong or the premises false, and the conclusion nevertheless true, though not in virtue of such illation or of such premises. I say that in every other science men prove their conclusions by their principles, and not their principles by the conclusions. But if in yours you should allow yourselves this unnatural way of proceeding, the consequence would be that you must take up with induction, and bid adieu to demonstration. And if you submit to this, your authority will no longer lead the way in points of reason and science.

XX. I have no controversy about your conclusions, but only about your logic and method: how you demonstrate; what objects you are conversant with, and whether you conceive them clearly; what principles you proceed upon; how sound they may be; and how you apply them. It must be remembered that I am not concerned about the truth of your theorems, but only about the way of coming at them; whether it be legitimate or illegitimate, clear or obscure, scientific or tentative. To prevent all possibility of your mistaking me, I beg leave to repeat and insist, that I consider the geometrical analyst as a logician, i. e. so far forth as he reasons and argues, and his mathematical conclusions, not in themselves, but in their premises; not as true or false, useful or insignificant, but as derived from such principles, and by such inferences. And forasmuch as it may perhaps seem an unaccountable paradox, that mathematicians should deduce true propositions from false principles, be right in the conclusion, and yet err in the premises; I shall endeavour particularly to explain why this may come to pass, and show how error may bring forth truth, though it cannot bring forth science.

XXI. In order therefore to clear up this point, we will suppose, for instance, that a tangent is to be drawn to a parabola, and examine the progress of this affair, as it is performed by infinitesimal differences. Let A B be a curve, the abscis A P = x, the ordinate P B = y, the difference of the abscis P M = dx, the difference of the ordinate R N = dy. Now by supposing the curve to be a polygon, and consequently B N, the increment or difference of the curve, to be a straight line coincident with the tangent, and the differential triangle B R N to be similiar to the triangle T P B, the subtangent P T is found a fourth proportional to R N : R B : P B: that is to $dy : dx : y$. Hence the subtangent will be $\frac{y\,dx}{dy}$. But



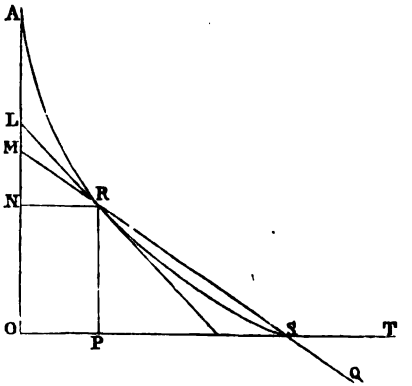
herein there is an error arising from the forementioned false supposition, whence the value of P T comes out greater than the truth: for in reality it is not the triangle R N B, but R L B, which is similar to P B T, and therefore (instead of R N) R L should have been the first term of the proportion, i. e. R N + N L, i. e. $dy + z$: whence the true expression for the subtangent should have been $\frac{y\,dx}{dy+z}$. There was therefore an error of defect in making dy the divisor: which error was equal to z, i. e. N L the line comprehended between the curve and the tangent. Now by the nature of the curve $y\,y = p\,x$, supposing p to be the parameter, whence by the rule of differences $2\,y\,dy = p\,d\,x$ and $dy = \frac{p\,dx}{2\,y}$. But if you multiply $y + dy$ by itself, and retain the whole product without rejecting the square of the difference, it will then come out, by substituting the augmented quantities in the equation of the curve, that $dy = \frac{p\,dx}{2\,y} - \frac{dy\,dy}{2\,y}$ truly. There was therefore an error of excess in making $dy = \frac{p\,dx}{2\,y}$, which followed from the erroneous rule of differences. And the measure of this second error is $\frac{dy\,dy}{2\,y} = z$. Therefore the two errors, being equal and contrary, destroy each other; the first error of defect being corrected by a second error of excess.

XXII. If you had committed only one error, you would not have come at a true solution of the problem. But by virtue of a twofold mistake you arrive, though not at science, yet at truth. For science it cannot be called, when you proceed blindfold, and

arrive at the truth not knowing how or by what means. To demonstrate that z is equal to $\frac{dy\,dy}{2y}$, let B R or $d\,x$ be m, and R N or dy be n. By the thirty-third proposition of the first book of the Conics of Apollonius, and from similar triangles, as $2x$ to y so is m to $n + z = \frac{m\,y}{2x}$. Likewise from the nature of the parabola $y\,y + 2\,y\,n + n\,n = x\,p + m\,p$, and $2\,y\,n + n\,n = m\,p$: wherefore $\frac{2\,y\,n + n\,n}{p} = m$: and because $y\,y = p\,x$, $\frac{y\,y}{p}$ will be equal to x. Therefore substituting these values instead of m and x we shall have $n + z = \frac{m\,y}{2\,x} = \frac{2\,y\,y\,n\,p + y\,n\,n\,p}{2\,y\,y\,p}$: i. e. $n + z = \frac{2\,y\,n + n\,n}{2\,y}$: which being reduced gives $z = \frac{n\,n}{2\,y} = \frac{dy\,dy}{2\,y}$ Q. E. D.

XXIII. Now I observe in the first place, that the conclusion comes out right, not because the rejected square of $d\,y$ was infinitely small; but because this error was compensated by another contrary and equal error. I observe in the second place, that whatever is rejected, be it ever so small, if it be real, and consequently makes a real error in the premises, it will produce a proportional real error in the conclusion. Your theorems therefore cannot be accurately true, nor your problems accurately solved, in virtue of premises which themselves are not accurate: it being a rule in logic that *conclusio sequitur partem debiliorem.* Therefore I observe in the third place, that when the conclusion is evident and the premises obscure, or the conclusion accurate and the premises inaccurate, we may safely pronounce that such conclusion is neither evident nor accurate, in virtue of those obscure, inaccurate premises or principles; but in virtue of some other principles which perhaps the demonstrator himself never knew or thought of. I observe in the last place, that in case the differences are supposed finite quantities ever so great, the conclusion will nevertheless come out the same; inasmuch as the rejected quantities are legitimately thrown out, not for their smallness, but for another reason, to wit, because of contrary errors, which destroying each other do upon the whole cause that nothing is really, though something is apparently, thrown out. And this reason holds equally with respect to quantities finite as well as infinitesimal, great as well as small, a foot or a yard long, as well as the minutest increment.

XXIV. For the fuller illustration of this point, I shall consider it in another light, and proceeding in finite quantities to the conclusion, I shall only then make use of one infinitesimal. Suppose the straight line M Q cuts the curve A T in the points R and S. Suppose L R a tangent at the point R, A N the



abscis, N R and O S ordinates. Let A N be produced to O, and R P be drawn parallel to N O. Suppose A N $= x$, N R $= y$, N O $= v$, P S $= z$, the subsecant M N $= s$. Let the equation $y = xx$ express the nature of the curve: and supposing y and x increased by their finite increments, we get $y + z = xx + 2xv + vv$: whence the former equation being subducted, there remains $z = 2xv + vv$. And by reason of similar triangles P S : P R :: N R : N M, i. e. $z : v :: y : s = \frac{vy}{z}$, wherein if for y and z we substitute their values, we get $\frac{vxx}{2xv + vv} = s = \frac{xx}{2x + v}$. And supposing N O to be infinitely diminished, the subsecant N M will in that case coincide with the subtangent N L, and v as an infinitesimal may be rejected: whence it follows that S $=$ N L $= \frac{xx}{2x} = \frac{x}{2}$; which is the true value of the subtangent. And since this was obtained by one only error, i. e. by once rejecting one only infinitesimal, it should seem, contrary to what hath been said, that an infinitesimal quantity or difference may be neglected or thrown away, and the conclusion nevertheless be accurately true, although there was no double mistake or rectifying of one error by another, as in the first case. But if this point be thoroughly considered, we shall find there is even here a double mistake, and that one compensates or rectifies the other. For in the first place, it was supposed, that when N O is infinitely diminished or becomes an infinitesimal, then the subsecant N M becomes equal to the subtangent N L. But this is a plain mistake; for it is evident, that as a secant cannot be a tangent, so a subsecant cannot be a subtangent. Be the difference ever so small, yet still there is a difference. And if N O be infinitely small, there will even then be an infinitely small difference between N M and N L. Therefore N M or S was too little for your supposition (when you supposed it equal to N L), and this

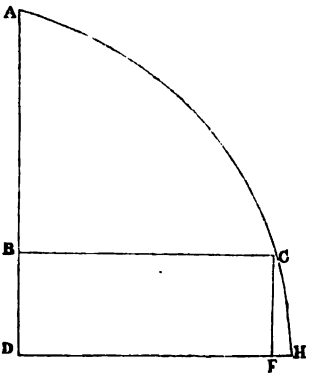
error was compensated by a second error in throwing out v, which last error made s bigger than its true value, and in lieu thereof gave the value of the subtangent. This is the true state of the case, however it may be disguised. And to this in reality it amounts, and is at bottom the same thing, if we should pretend to find the subtangent by having first found, from the equation of the curve and similar triangles, a general expression for all subsecants, and then reducing the subtangent under this general rule, by considering it as the subsecant when v vanishes, or becomes nothing.

XXV. Upon the whole I observe, first, that v can never be nothing, so long as there is a secant. Secondly, that the same line cannot be both tangent and secant. Thirdly, that when v or N O* vanisheth, P S and S R do also vanish, and with them the proportionality of the similar triangles. Consequently the whole expression, which was obtained by means thereof and grounded thereupon, vanisheth when v vanisheth. Fourthly, that the method for finding secants or the expression of secants, be it ever so general, cannot in common sense extend any further than to all secants whatsoever; and, as it necessarily supposed similar triangles, it cannot be supposed to take place where there are not similar triangles. Fifthly, that the subsecant will always be less than the subtangent, and can never coincide with it; which coincidence to suppose would be absurd: for it would be supposing the same line at the same time to cut and not to cut another given line, which is a manifest contradiction, such as subverts the hypothesis and gives a demonstration of its falsehood. Sixthly, if this be not admitted, I demand a reason why any other apagogical demonstration, or demonstration *ad absurdum*, should be admitted in geometry rather than this; or that some real difference be assigned between this and others as such. Seventhly, I observe that it is sophistical to suppose N O or R P, P S, and S R to be finite real lines in order to form the triangle R P S, in order to obtain proportions by similar triangles; and afterwards to suppose there are no such lines, nor consequently similar triangles, and nevertheless to retain the consequence of the first supposition, after such supposition hath been destroyed by a contrary one. Eighthly, that although in the present case, by inconsistent suppositions truth may be obtained, yet such truth is not demonstrated; that such method is not conformable to the rules of logic and right reason; that, however useful it may be, it must be considered only as a presumption, as a knack, an art, rather an artifice, but not a scientific demonstration.

XXVI. The doctrine premised may be further illustrated by the following simple and easy case, wherein I shall proceed by evanescent increments. Suppose A B $= x$, B C $= y$, B D $= o$,

* See the foregoing figure.

and that xx is equal to the area A B C: it is proposed to find the ordinate y or B C. When x by flowing becomes $x + o$, then



$x\,x$ becomes $x\,x + 2\,x\,o + o\,o$: and the area A B C becomes A D H, and the increment of xx will be equal to B D H C the increment of the area, i. e. to B C F D + C F H. And if we suppose the curvilinear space C F H to be $q\,o\,o$, then $2\,x\,o + o\,o = y\,o + q\,o\,o$, which divided by o gives $2\,x + o = y + q\,o$. And, supposing o to vanish, $2\,x = y$, in which case A C H will be a straight line, and the areas A B C, C F H, triangles. Now with regard to this reasoning, it hath been already remarked,* that it is not legitimate or logical to suppose o to vanish, i. e. to be nothing, i. e. that there is no increment, unless we reject at the same time with the increment itself every consequence of such increment, i. e. whatsoever could not be obtained but by supposing such increment. It must nevertheless be acknowledged, that the problem is rightly solved, and the conclusion true, to which we are led by this method. It will therefore be asked, how comes it to pass that the throwing out o is attended with no error in the conclusion? I answer, the true reason hereof is plainly this: because q being unit, $q\,o$ is equal to o: and therefore $2\,x + o - qo = y = 2\,x$, the equal quantities $q\,o$ and o being destroyed by contrary signs.

XXVII. As on the one hand it were absurd to get rid of o by saying, let me contradict myself; let me subvert my own hypothesis; let me take it for granted that there is no increment, at the same time that I retain a quantity, which I could never have got at but by assuming an increment: so on the other hand it would be equally wrong to imagine, that in a geometrical demonstration we may be allowed to admit any error, though ever so small, or that it is possible, in the nature of things, an accurate conclusion should be derived from inaccurate principles.

* Sect xiii. and xiii. supra.

Therefore o cannot be thrown out as an infinitesimal, or upon the principle that infinitesimals may be safely neglected; but only because it is destroyed by an equal quantity with a negative sign, whence $o - po$ is equal to nothing. And as it is illegitimate to reduce an equation, by subducting from one side a quantity when it is not to be destroyed, or when an equal quantity is not subducted from the other side of the equation: so it must be allowed a very logical and just method of arguing, to conclude that if from equals either nothing or equal quantities are subducted, they shall still remain equal. And this is a true reason why no error is at last produced by the rejecting of o. Which therefore must not be ascribed to the doctrine of differences, or infinitesimals, or evanescent quantities, or momentums, or fluxions.

XXVIII. Suppose the case to be general, and that x^n is equal to the area A B C, whence by the method of fluxions the ordinate is found nx^{n-1}, which we admit for true, and shall inquire how it is arrived at. Now if we are content to come at the conclusion in a summary way, by supposing that the ratio of the fluxions of x and x^n is found* to be 1 and $n\,x^{n-1}$, and that the ordinate of the area is considered as its fluxion; we shall not so clearly see our way, or perceive how the truth comes out, that method, as we have shown before, being obscure and illogical. But if we fairly delineate the area and its increment, and divide the latter in two parts B C F D and C F H,† and proceed regularly by equations between the algebraical and geometrical quantities, the reason of the thing will plainly appear. For as x^n is equal to the area A B C, so is the increment of x^n equal to the increment of the area, i. e. to B D H C; that is to say $n\,o\,x^{n-1} + \frac{nn-n}{2}o\,o\,x^{n-2}$ + &c. = BDFC + CFH. And only the first members on each side of the equation being retained, $n\,o\,x^{n-1}$ = B D F C: and dividing both sides by o or B D, we shall get $n\,x^{n-1}$ = B C. Admitting therefore, that the curvilinear space C F H is equal to the rejectaneous quantity $\frac{nn-n}{2}o\,o\,x^{n-2}$ + &c.; and that when this is rejected on one side, that is rejected on the other, the reasoning becomes just and the conclusion true. And it is all one whatever magnitude you allow to B D, whether that of an infinitesimal difference or a finite increment ever so great. It is therefore plain, that the supposing the rejectaneous algebraical quantity to be an infinitely small or evanescent quantity, and therefore to be neglected, must have produced an error, had it not been for the curvilinear spaces being equal thereto, and at the same time subducted from the other part or side of the equation, agreeably to the axiom: 'If

* Sect. xiii. † See the figure in Sect. xxvi.

from equals you subduct equals, the remainders will be equal. For those quantities, which by the analysts are said to be neglected, or made to vanish, are in reality subducted. If therefore the conclusion be true, it is absolutely necessary that the finite space C F H be equal to the remainder of the increment expressed by $\frac{nn-n}{2}\ o\ o\ x^{n-2}$ &c., equal, I say, to the finite remainder of a finite increment.

XXIX. Therefore, be the power what you please, there will arise on one side an algebraical expression, on the other a geometrical quantity, each of which naturally divides itself into three members; the algebraical or fluxionary expression into one, which includes neither the expression of the increment of the abscis nor of any power thereof; another which includes the expression of the increment itself; and a third including the expression of the powers of the increment. The geometrical quantity also or whole increased area consists of three parts or members, the first of which is the given areas, the second a rectangle under the ordinate and the increment of the abscis, and the third a curvilinear space. And, comparing the homologous or correspondent members on both sides, we find that as the first member of the expression is the expression of the given area, so the second member of the expression will express the rectangle or second member of the geometrical quantity; and the third, containing the powers of the increment, will express the curvilinear space or third member of the geometrical quantity. This hint may perhaps be further extended, and applied to good purpose, by those who have leisure and curiosity for such matters. The use I make of it is to show, that the analysis cannot obtain in augments or differences, but it must also obtain in finite quantities, be they ever so great, as was before observed.

XXX. It seems therefore upon the whole, that we may safely pronounce the conclusion cannot be right, if in order thereto any quantity be made to vanish, or be neglected, except that either one error is redressed by another; or that, secondly, on the same side of an equation equal quantities are destroyed by contrary signs, so that the quantity we mean to reject is first annihilated; or lastly, that from the opposite sides equal quantities are subducted. And therefore to get rid of quantities by the received principles of fluxions or of differences is neither good geometry nor good logic. When the augments vanish, the velocities also vanish. The velocities or fluxions are said to be *primò* and *ultimò*, as the augments nascent and evanescent. Take therefore the ratio of the evanescent quantities, it is the same with that of the fluxions: it will therefore answer all intents as well. Why then are fluxions introduced? Is it not to shun or rather to palliate the use of quantities infinitely small? But we

have no notion whereby to conceive and measure various degrees of velocity, besides space and time, or when the times are given, besides space alone. We have even no notion of velocity prescinded from time and space. When therefore a point is supposed to move in given times, we have no notion of greater or lesser velocities or of proportions between velocities, but only of longer or shorter lines, and of proportions between such lines generated in equal parts of time.

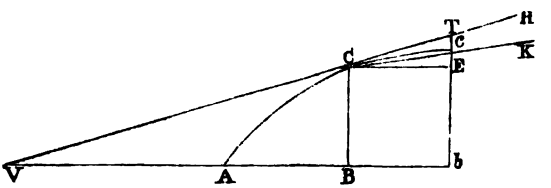
XXXI. A point may be the limit of a line: a line may be the limit of a surface: a moment may terminate time. But how can we conceive a velocity by the help of such limits? It necessarily implies both time and space, and cannot be conceived without them. And if the velocities of nascent and evanescent quantities, i. e. abstracted from time and space, may not be comprehended, how can we comprehend and demonstrate their proportions; or consider their *rationes primæ* and *ultimæ?* For to consider the proportion or *ratio* of things implies that such things have magnitude; that such their magnitudes may be measured, and their relations to each other known. But as there is no measure of velocity except time and space, the proportion of velocities being only compounded of the direct proportion of the spaces and the reciprocal proportion of the times; doth it not follow that to talk of investigating, obtaining, and considering the proportions of velocities, exclusively of time and space, is to talk unintelligibly?

XXXII. But you will say that, in the use and application of fluxions, men do not overstrain their faculties to a precise conception of the above-mentioned velocities, increments, infinitesimals, or any other such like ideas of a nature so nice, subtile, and evanescent. And therefore you will perhaps maintain, that problems may be solved without those inconceivable suppositions; and that, consequently, the doctrine of fluxions, as to the practical part, stands clear of all such difficulties. I answer, that if in the use or application of this method those difficult and obscure points are not attended to, they are nevertheless supposed. They are the foundations on which the moderns build the principles on which they proceed, in solving problems and discovering theorems. It is with the method of fluxions as with all other methods, which presuppose their respective principles and are grounded thereon; although the rules may be practised by men who neither attend to, nor perhaps know, the principles. In like manner, therefore, as a sailor may practically apply certain rules derived from astronomy and geometry, the principles whereof he doth not understand: and as any ordinary man may solve divers numerical questions by the vulgar rules and operations of arithmetic, which he performs and applies without knowing the reasons of them: even so it cannot be denied that you may apply

the rules of the fluxionary method: you may compare and reduce particular cases to the general forms; you may operate, and compute, and solve problems thereby, not only without an actual attention to, or an actual knowledge of, the grounds of that method, and the principles whereon it depends, and whence it is deduced, but even without having ever considered or comprehended them.

XXXIII. But then it must be remembered, that in such case, although you may pass for an artist, computist, or analyst, yet you may not be justly esteemed a man of science and demonstration. Nor should any man, in virtue of being conversant in such obscure analytics, imagine his rational faculties to be more improved than those of other men, which have been exercised in a different manner, and on different subjects; much less erect himself into a judge and an oracle, concerning matters that have no sort of connexion with, or dependence on, those species, symbols, or signs, in the management whereof he is so conversant and expert. As you, who are a skilful computist or analyst, may not therefore be deemed skilful in anatomy; or *vice versâ*, as a man who can dissect with art, may, nevertheless, be ignorant in your art of computing: even so you may both, notwithstanding your peculiar skill in your respective arts, be alike unqualified to decide upon logic, or metaphysics, or ethics, or religion. And this would be true, even admitting that you understood your own principles and could demonstrate them.

XXXIV. If it is said, that fluxions may be expounded or expressed by finite lines proportional to them; which finite lines, as they may be distinctly conceived, and known, and reasoned upon, so they may be substituted for the fluxions, and their mutual relations or proportions be considered as the proportions of fluxions; by which means the doctrine becomes clear and useful: I answer that if, in order to arrive at these finite lines proportional to the fluxions, there be certain steps made use of which are obscure and inconceivable, be those finite lines themselves ever so clearly conceived, it must nevertheless be acknowledged, that your proceeding is not clear, nor your method scientific. For instance, it is supposed that A B being



the absciss, B C the ordinate, and V C H a tangent of the curve A C, B *b* or C E the increment of the absciss, E *c* the increment

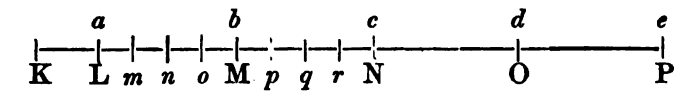
of the ordinate, which produced meets V H in the point T, and C *c* the increment of the curve. The right line C *c* being produced to K, there are formed three small triangles, the rectilinear C E *c*, the mixtilinear C E *c*, and the rectilinear triangle C E T. It is evident these three triangles are different from each other, the rectilinear C E *c* being less than the mixtilinear C E *c*, whose sides are the three increments above mentioned, and this still less than the triangle C E T. It is supposed that the ordinate *b c* moves into the place B C, so that the point *c* is coincident with the point C; and the right line C K, and consequently the curve C *c*, is coincident with the tangent C H. In which case the mixtilinear evanescent triangle C E *c* will, in its last form, be similar to the triangle C E T: and its evanescent sides C E, E *c*, and C *c* will be proportional to C E, E T, and C T, the sides of the triangle C E T. And therefore it is concluded, that the fluxions of the lines A B, B C, and A C, being in the last ratio of their evanescent increments, are proportional to the sides of the triangle C E T, or, which is all one, of the triangle V B C, similar thereunto. * It is particularly remarked and insisted on by the great author, that the points C and *c* must not be distant one from another, by any the least interval whatsoever: but that, in order to find the ultimate proportions of the lines C E, E *c*, and C *c* (i. e. the proportions of the fluxions or velocities), expressed by the finite sides of the triangle V B C, the points C and *c* must be accurately coincident, i. e., one and the same. A point therefore is considered as a triangle, or a triangle is supposed to be formed in a point. Which to conceive seems quite impossible. Yet some there are, who, though they shrink at all other mysteries, make no difficulty of their own, who "strain at a gnat and swallow a camel."

XXXV. I know not whether it be worth while to observe, that possibly some men may hope to operate by symbols and suppositions, in such sort as to avoid the use of fluxions, momentums, and infinitesimals, after the following manner. Suppose x to be one abscis of a curve, and z another abscis of the same curve. Suppose also that the respective areas are xxx and zzz: and that $z-x$ is the increment of the abscis, and $zzz-xxx$ the increment of the area, without considering how great or how small those increments may be. Divide now $zzz-xxx$ by $z-x$ and the quotient will be $zz+zx+xx$: and, supposing that z and x are equal, this same quotient will be $3xx$, which in that case is the ordinate, which therefore may be thus obtained independently of fluxions and infinitesimals. But herein is a direct fallacy: for, in the first place, it is supposed that the abscisses z and x are unequal, without which supposition no one step could have been made; and, in the second

* Introd. ad Quadraturam Curvarum.

place, it is supposed they are equal; which is a manifest inconsistency, and amounts to the same thing that hath been before considered.* And there is indeed reason to apprehend, that all attempts for setting the abstruse and fine geometry on a right foundation, and avoiding the doctrine of velocities, momentums, &c., will be found impracticable, till such time as the object and end of geometry are better understood, than hitherto they seem to have been. The great author of the method of fluxions felt this difficulty, and therefore he gave in to those nice abstractions and geometrical metaphysics, without which he saw nothing could be done on the received principles; and what in the way of demonstration he hath done with them the reader will judge. It must, indeed, be acknowledged, that he used fluxions, like the scaffold of a building, as things to be laid aside or got rid of, as soon as finite lines were found proportional to them. But then these finite exponents are found by the help of fluxions. Whatever, therefore, is got by such exponents and proportions is to be ascribed to fluxions: which must therefore be previously understood. And what are these fluxions? The velocities of evanescent increments? And what are these same evanescent increments? They are neither finite quantities, nor quantities infinitely small, nor yet nothing. May we not call them the ghosts of departed quantities?

XXXVI. Men too often impose on themselves and others, as if they conceived and understood things expressed by signs, when in truth they have no idea, save only of the very signs themselves. And there are some grounds to apprehend that this may be the present case. The velocities of evanescent or nascent quantities are supposed to be expressed, both by finite lines of a determinate magnitude, and by algebraical notes or signs: but I suspect that many who, perhaps never having examined the matter, take it for granted, would upon a narrow scrutiny find it impossible to frame any idea or notion whatsoever of those velocities, exclusive of such finite quantities and signs.



Suppose the line K P described by the motion of a point continually accelerated, and that in equal particles of time the unequal parts K L, L M, M N, N O, &c., are generated. Suppose also that *a*, *b*, *c*, *d*, *e*, &c., denote the velocities of the generating point, at the several periods of the parts or increments so generated. It is easy to observe, that these increments are each proportional to the sum of the velocities with which it is described: that, consequently, the several sums of the velocities,

* Sect. xv.

generated in equal parts of time, may be set forth by the respective lines K L, L M, M N, &c., generated in the same times: it is likewise an easy matter to say, that the last velocity generated in the first particle of time, may be expressed by the symbol a, the last in the second by b, the last generated in the third by c, and so on: that a is the velocity of L M in *statu nascenti*, and b, c, d, e, &c., are the velocities of the increments M N, N O, O P, &c., in their respective nascent estates. You may proceed, and consider these velocities themselves as flowing or increasing quantities, taking the velocities of the velocities, and the velocities of the velocities of the velocities, i. e., the first, second, third, &c., velocities, *ad infinitum:* which succeeding series of velocities may be thus expressed, $a.\ b - a.\ c - 2\ b + a.\ d - 3\ c + 3\ b - a$, &c., which you may call by the names of first, second, third, fourth fluxions. And for an apter expression you may denote the variable flowing line K L, K M, K N, &c., by the letter x; and the first fluxions by $\dot{x}$, the second by $\ddot{x}$, the third by $\dddot{x}$, and so on, *ad infinitum.*

XXXVII. Nothing is easier than to assign names, signs, or expressions to these fluxions, and it is not difficult to compute and operate by means of such signs. But it will be found much more difficult to omit the signs, and yet retain in our minds the things which we suppose to be signified by them. To consider the exponents, whether geometrical, or algebraical, or fluxionary, is no difficult matter. But to form a precise idea of a third velocity, for instance, in itself and by itself, *hoc opus, hic labor.* Nor, indeed, is it an easy point to form a clear and distinct idea of any velocity at all, exclusive of and prescinding from all length of time and space; as also from all notes, signs, or symbols whatsoever. This, if I may be allowed to judge of others by myself, is impossible. To me it seems evident, that measures and signs are absolutely necessary, in order to conceive or reason about velocities; and that, consequently, when we think to conceive the velocities, simply and in themselves, we are deluded by vain abstractions.

XXXVIII. It may perhaps be thought by some an easier method of conceiving fluxions, to suppose them the velocities wherewith the infinitesimal differences are generated. So that the first fluxions shall be the velocities of the first differences, the second the velocities of the second differences, the third fluxions the velocities of the third differences, and so on, *ad infinitum.* But, not to mention the insurmountable difficulty of admitting or conceiving infinitesimals, and infinitesimals of infinitesimals, &c., it is evident that this notion of fluxions would not consist with the great author's view; who held that the minutest quantity ought not to be neglected, that therefore the

doctrine of infinitesimal differences was not to be admitted in geometry; and who plainly appears to have introduced the use of velocities or fluxions, on purpose to exclude or do without them.

XXXIX. To others it may possibly seem, that we should form a juster idea of fluxions, by assuming the finite, unequal, isochronal increments K L, L M, M N, &c., and considering them in *statu nascenti*, also their increments in *statu nascenti*, and the nascent increments of those increments, and so on, supposing the first nascent increments to be proportional to the first fluxions or velocities, the nascent increments of those increments to be proportional to the second fluxions, the third nascent increments to be proportional to the third fluxions, and so onwards. And, as the first fluxions are the velocities of the first nascent increments, so the second fluxions may be conceived to be the velocities of the second nascent increments, rather than the velocities of velocities. By which means the analogy of fluxions may seem better preserved, and the notion rendered more intelligible.

XL. And indeed it should seem, that in the way of obtaining the second or third fluxion of an equation, the given fluxions were considered rather as increments than velocities. But the considering them sometimes in one sense, sometimes in another, one while in themselves, another in their exponents, seems to have occasioned no small share of that confusion and obscurity which is found in the doctrine of fluxions. It may seem, therefore, that the notion might be still mended, and that instead of fluxions of fluxions, or fluxions of fluxions of fluxions, and instead of second, third, or fourth, &c., fluxions of a given quantity, it might be more consistent and less liable to exception to say, the fluxion of the first nascent increment, i. e., the second fluxion; the fluxion of the second nascent increment, i. e., the third fluxion; the fluxion of the third nascent increment, i. e., the fourth fluxion, which fluxions are conceived respectively proportional, each to the nascent principle of the increment succeeding that whereof it is the fluxion.

XLI. For the more distinct conception of all which it may be considered, that if the finite increment L M* be divided into the isochronal parts L m, m n, n o, o M; and the increment M N into the parts M p, p q, q r, r N, isochronal to the former; as the whole increments L M, M N, are proportional to the sums of their describing velocities, even so the homologous particles L m, M p are also proportional to the respective accelerated velocities with which they are described. And as the velocity with which M p is generated, exceeds that with which L m was generated, even so the particle M p exceeds the particle L m. And in general, as the isochronal velocities describ-

* See the foregoing scheme in sect. xxxvi.

ing the particles of M N exceed the isochronal velocities describing the particles of L M, even so the particles of the former exceed the correspondent particles of the latter. And this will hold, be the said particles ever so small. M N therefore will exceed L M if they are both taken in their nascent states: and that excess will be proportional to the excess of the velocity b above the velocity a. Hence we may see that this last account of fluxions comes, in the upshot, to the same thing with the first.*

XLII. But notwithstanding what hath been said, it must still be acknowledged, that the finite particles L m or M p, though taken ever so small, are not proportional to the velocities a and b; but each to a series of velocities changing every moment, or which is the same thing, to an accelerated velocity, by which it is generated, during a certain minute particle of time: that the nascent beginnings or evanescent endings of finite quantities, which are produced in moments or infinitely small parts of time, are alone proportional to given velocities: that therefore, in order to conceive the first fluxions, we must conceive time divided into moments, increments generated in those moments, and velocities proportional to those increments: that in order to conceive second and third fluxions, we must suppose that the nascent principles or momentaneous increments have themselves also other momentaneous increments, which are proportional to their respective generating velocities; that the velocities of these second momentaneous increments are second fluxions: those of their nascent momentaneous increments third fluxions. And so on *ad infinitum*.

XLIII. By subducting the increment generated in the first moment from that generated in the second, we get the increment of an increment. And by subducting the velocity generating in the first moment from that generating in the second, we get the fluxion of a fluxion. In like manner, by subducting the difference of the velocities generating in the two first moments, from the excess of the velocity in the third above that in the second moment, we obtain the third fluxion. And after the same analogy we may proceed to fourth, fifth, sixth fluxions, &c. And if we call the velocities of the first, second, third, fourth moments, a, b, c, d, the series of fluxions will be as above, $a.\ b - a.\ c - 2\ b + a.\ d - 3\ c + 3\ b - a.$ *ad infinitum*, i. e. $\dot{x}.\ \ddot{x}.\ \dddot{x}.\ \ddddot{x}.$ *ad infinitum*.

XLIV. Thus fluxions may be considered in sundry lights and shapes, which seem all equally difficult to conceive. And indeed, as it is impossible to conceive velocity without time or space, without either finite length or finite duration,† it must seem above the powers of men to comprehend even the first fluxions. And if the first are incomprehensible, what shall we say of the second

* Sect. xxxvi. † Sect. xxxi.

and third fluxions, &c.? He who can conceive the beginning of a beginning, or the end of an end, somewhat before the first or after the last, may be perhaps sharp-sighted enough to conceive these things. But most men will, I believe, find it impossible to understand them in any sense whatever.

XLV. One would think that men could not speak too exactly on so nice a subject. And yet, as was before hinted, we may often observe that the exponents of fluxions, or notes representing fluxions, are confounded with the fluxions themselves. Is not this the case, when just after the fluxions of flowing quantities were said to be the celerities of their increasing, and the second fluxions to be the mutations of the first fluxions or celerities, we are told that $z.\ z.\ z.\ \dot{z}.\ \ddot{z}.\ \dddot{z}.$* represents a series of quantities, whereof each subsequent quantity is the fluxion of the preceding; and each foregoing is a fluent quantity having the following one for its fluxion?

XLVI. Divers series of quantities and expressions, geometrical and algebraical, may be easily conceived, in lines, in surfaces, in species, to be continued without end or limit. But it will not be found so easy to conceive a series, either of mere velocities, or of mere nascent increments, distinct therefrom and corresponding thereunto. Some perhaps may be led to think the author intended a series of ordinates, wherein each ordinate was the fluxion of the preceding and fluent of the following, i. e. that the fluxion of one ordinate was itself the ordinate of another curve; and the fluxion of this last ordinate was the ordinate of yet another curve; and so on *ad infinitum*. But who can conceive how the fluxion (whether velocity or nascent increment) of an ordinate? Or more than that each preceding quantity or fluent is related to its subsequent or fluxion, as the area of curvilinear figure to its ordinate; agreeably to what the author remarks, that each preceding quantity in such series is as the area of a curvilinear figure, whereof the absciss is z, and the ordinate is the following quantity.

XLVII. Upon the whole it appears that the celerities are dismissed, and instead thereof areas and ordinates are introduced. But however expedient such analogies or such expressions may be found for facilitating the modern quadratures, yet we shall not find any light given us thereby into the original real nature of fluxions; or that we are enabled to frame from thence just ideas of fluxions considered in themselves. In all this the general ultimate drift of the author is very clear; but his principles are obscure. But perhaps those theories of the great author are not minutely considered or canvassed by his disciples: who seem eager, as was before hinted, rather to operate than to know,

* De Quadraturâ Curvarum.

rather to apply his rules and his forms, than to understand his principles and enter into his notions. It is nevertheless certain, that in order to follow him in his quadratures, they must find fluents from fluxions; and in order to this, they must know to find fluxions from fluents: and in order to find fluxions, they must first know what fluxions are. Otherwise they proceed without clearness and without science. Thus the direct method precedes the inverse, and the knowledge of the principles is supposed in both. But as for operating according to rules, and by the help of general forms, whereof the original principles and reasons are not understood, this is to be esteemed merely technical. Be the principles therefore ever so abstruse and metaphysical, they must be studied by whoever would comprehend the doctrine of fluxions. Nor can any geometrician have a right to apply the rules of the great author, without first considering his metaphysical notions whence they were derived. These, how necessary soever in order to science, which can never be attained without a precise, clear, and accurate conception of the principles, are nevertheless by several carelessly passed over; while the expressions alone are dwelt on and considered and treated with great skill and management, thence to obtain other expressions by methods suspicious and indirect (to say the least), if considered in themselves, however recommended by induction and authority; two motives which are acknowledged sufficient to beget a rational faith and moral persuasion, but nothing higher.

XLVIII. You may possibly hope to evade the force of all that hath been said, and to screen false principles and inconsistent reasonings, by a general pretence that these objections and remarks are metaphysical. But this is a vain pretence. For the plain sense and truth of what is advanced in the foregoing remarks, I appeal to the understanding of every unprejudiced, intelligent reader. To the same I appeal, whether the points remarked upon are not most incomprehensible metaphysics. And metaphysics not of mine, but your own. I would not be understood to infer, that your notions are false or vain because they are metaphysical. Nothing is either true or false for that reason. Whether a point be called metaphysical or no, avails little. The question is, whether it be clear or obscure, right or wrong, well or ill deduced?

XLIX. Although momentaneous increments, nascent and evanescent quantities, fluxions and infinitesimals of all degrees, are in truth such shadowy entities, so difficult to imagine or conceive distinctly, that (to say the least) they cannot be admitted as principles or objects of clear and accurate science: and although this obscurity and incomprehensibility of your metaphysics had been alone sufficient to allay your pretensions to evidence; yet it hath, if I mistake not, been further shown, that your in-

ferences are no more just than your conceptions are clear, and that your logics are as exceptionable as your metaphysics. It should seem therefore upon the whole, that your conclusions are not attained by just reasoning from clear principles; consequently, that the employment of modern analysts, however useful in mathematical calculations and constructions, doth not habituate and qualify the mind to apprehend clearly and infer justly; and consequently, that you have no right in virtue of such habits to dictate out of your proper sphere, beyond which your judgment is to pass for no more than that of other men.

L. Of a long time I have suspected, that these modern analytics were not scientifical, and gave some hints thereof to the public about twenty-five years ago. Since which time, I have been diverted by other occupations, and imagined I might employ myself better than in deducing and laying together my thoughts on so nice a subject. And though of late I have been called upon to make good my suggestions; yet as the person who made this call doth not appear to think maturely enough to understand, either those metaphysics which he would refute, or mathematics which he would patronize, I should have spared myself the trouble of writing for his conviction. Nor should I now have troubled you or myself with this address, after so long an intermission of these studies, were it not to prevent, so far as I am able, your imposing on yourself and others, in matters of much higher moment and concern. And to the end that you may more clearly comprehend the force and design of the foregoing remarks, and pursue them still further in your own meditations, I shall subjoin the following Queries.

Query 1. Whether the object of geometry be not the proportions of assignable extensions? And whether there be any need of considering quantities either infinitely great or infinitely small?

Qu. 2. Whether the end of geometry be not to measure assignable finite extension? And whether this practical view did not first put men on the study of geometry?

Qu. 3. Whether the mistaking the object and end of geometry hath not created needless difficulties, and wrong pursuits in that science?

Qu. 4. Whether men may properly be said to proceed in a scientific method, without clearly conceiving the object they are conversant about, the end proposed, and the method by which it is pursued?

Qu. 5. Whether it doth not suffice, that every assignable number of parts may be contained in some assignable magnitude? And whether it be not unnecessary, as well as absurd, to suppose that finite extension is infinitely divisible?

Qu. 6. Whether the diagrams in a geometrical demonstration

are not to be considered as signs of all possible finite figures, of all sensible and imaginable extensions or magnitudes of the same kind?

Qu. 7. Whether it be possible to free geometry from insuperable difficulties and absurdities, so long as either the abstract general idea of extension, or absolute external extension be supposed its true object?

Qu. 8. Whether the notions of absolute time, absolute place, and absolute motion be not most abstractedly metaphysical? Whether it be possible for us to measure, compute, or know them?

Qu. 9. Whether mathematicians do not engage themselves in disputes and paradoxes, concerning what they neither do nor can conceive? And whether the doctrine of forces be not a sufficient proof of this?*

Qu. 10. Whether in geometry it may not suffice to consider assignable finite magnitude, without concerning ourselves with infinity? And whether it would not be righter to measure large polygons having finite sides, instead of curves, than to suppose curves are polygons of infinitesimal sides, a supposition neither true nor conceivable?

Qu. 11. Whether many points, which are not readily assented to, are not nevertheless true? And whether those in the two following queries may not be of that number?

Qu. 12. Whether it be possible, that we should have had an idea or notion of extension prior to motion? Or whether, if a man had never perceived motion, he would ever have known or conceived one thing to be distant from another?

Qu. 13. Whether geometrical quantity hath coexistent parts? And whether all quantity be not in a flux as well as time and motion?

Qu. 14. Whether extension can be supposed an attribute of a being immutable and eternal?

Qu. 15. Whether to decline examining the principles, and unravelling the methods used in mathematics, would not show a bigotry in mathematicians?

Qu. 16. Whether certain maxims do not pass current among analysts, which are shocking to good sense? And whether the common assumption, that a finite quantity divided by nothing is infinite, be not of this number?

Qu. 17. Whether the considering geometrical diagrams absolutely or in themselves, rather than as representatives of all assignable magnitudes or figures of the same kind, be not a principal cause of the supposing finite extension infinitely divisible; and of all the difficulties and absurdities consequent thereupon?

Qu. 18. Whether from geometrical propositions being general,

* See the treatise Concerning Motion.

and the lines in diagrams being therefore general substitutes or representatives, it doth not follow that we may not limit or consider the number of parts into which such particular lines are divisible?

Qu. 19. When it is said or implied, that such a certain line delineated on paper contains more than any assignable number of parts, whether any more in truth ought to be understood, than that it is a sign indifferently representing all finite lines, be they ever so great: in which relative capacity it contains, i. e. stands for more than any assignable number of parts? And whether it be not altogether absurd to suppose a finite line, considered in itself or in its own positive nature, should contain an infinite number of parts?

Qu. 20. Whether all arguments for the infinite divisibility of finite extension do not suppose and imply, either general abstract ideas or absolute external extension to be the object of geometry? And therefore, whether, along with those suppositions, such arguments also do not cease and vanish?

Qu. 21. Whether the supposed infinite divisibility of finite extension hath not been a snare to mathematicians, and a thorn in their sides? And whether a quantity infinitely diminished, and a quantity infinitely small, are not the same thing?

Qu. 22. Whether it be necessary to consider velocities of nascent or evanescent quantities, or moments, or infinitesimals? And whether the introducing of things so inconceivable be not a reproach to mathematics?

Qu. 23. Whether inconsistencies can be truths? Whether points repugnant and absurd are to be admitted upon any subject, or in any science? And whether the use of infinites ought to be allowed, as a sufficient pretext and apology for the admitting of such points in geometry?

Qu. 24. Whether a quantity be not properly said to be known, when we know its proportion to given quantities? And whether this proportion can be known, but by expressions or exponents, either geometrical, algebraical, or arithmetical? And whether expressions in lines or species can be useful, but so far forth as they are reducible to numbers?

Qu. 25. Whether the finding out proper expressions or notations of quantity be not the most general character and tendency of the mathematics? And arithmetical operation that which limits and defines their use?

Qu. 26. Whether mathematicians have sufficiently considered the analogy and use of signs? And how far the specific limited nature of things corresponds thereto?

Qu. 27. Whether because, in stating a general case of pure algebra, we are at full liberty to make a character denote either a positive or a negative quantity, or nothing at all, we may

therefore, in a geometrical case, limited by hypotheses and reasonings, from particular properties and relations of figures, claim the same license?

Qu. 28. Whether the shifting of the hypothesis, or (as we may call it) the *fallacia suppositionis*, be not a sophism, that far and wide infects the modern reasonings, both in the mechanical philosophy and in the abstruse and fine geometry?

Qu. 29. Whether we can form an idea or notion of velocity distinct from and exclusive of its measures, as we can of heat distinct from and exclusive of the degrees on the thermometer, by which it is measured? And whether this be not supposed in the reasonings of modern analysts?

Qu. 30. Whether motion can be conceived in a point of space? And if motion cannot, whether velocity can? And if not, whether a first or last velocity can be conceived in a mere limit, either initial or final, of the described space?

Qu. 31. Where there are no increments, whether there can be any ratio of increments? Whether nothings can be considered as proportional to real quantities? Or whether to talk of their proportions be not to talk nonsense? Also in what sense we are to understand the proportion of a surface to a line, of an area to an ordinate? And whether species or numbers, though properly expressing quantities which are not homogeneous, may yet be said to express their proportion to each other?

Qu. 32. Whether, if all assignable circles may be squared, the circle is not, to all intents and purposes, squared as well as the parabola? Or whether a parabolical area can in fact be measured more accurately than a circular?

Qu. 33. Whether it would not be righter to approximate fairly, than to endeavour at accuracy by sophisms?

Qu. 34. Whether it would not be more decent to proceed by trials and inductions, than to pretend to demonstrate by false principles?

Qu. 35. Whether there be not a way of arriving at truth, although the principles are not scientific, nor the reasoning just? And whether such a way ought to be called a knack or a science?

Qu. 36. Whether there can be science of the conclusion, where there is not evidence of the principles? And whether a man can have evidence of the principles, without understanding them? And therefore whether the mathematicians of the present age act like men of science, in taking so much more pains to apply their principles, than to understand them?

Qu. 37. Whether the greatest genius wrestling with false principles may not be foiled? And whether accurate quadratures can be obtained without new *postulata* or assumptions? And if not, whether those which are intelligible and consistent ought not to be preferred to the contrary? See Sect. XXVIII. and XXIX.

Qu. 38. Whether tedious calculations in algebra and fluxions be the likeliest method to improve the mind? And whether men's being accustomed to reason altogether about mathematical signs and figures, doth not make them at a loss how to reason without them?

Qu. 39. Whether, whatever readiness analysts acquire in stating a problem, or finding apt expressions for mathematical quantities, the same doth necessarily infer a proportionable ability in conceiving and expressing other matters?

Qu. 40. Whether it be not a general case or rule, that one and the same coefficient dividing equal products gives equal quotients? And yet whether such coefficient can be interpreted by o or nothing? Or whether any one will say, that if the equation $2 \times o = 5 \times o$, be divided by o, the quotient on both sides are equal? Whether therefore a case may not be general with respect to all quantities, and yet not extend to nothings, or include the case of nothing? And whether the bringing nothing under the notion of quantity may not have betrayed men into false reasoning?

Qu. 41. Whether, in the most general reasonings about equalities and proportions, men may not demonstrate as well as in geometry? Whether in such demonstrations they are not obliged to the same strict reasoning as in geometry? And whether such their reasonings are not deduced from the same axioms with those in geometry? Whether, therefore, algebra be not as truly a science as geometry?

Qu. 42. Whether men may not reason in species as well as in words? Whether the same rules of logic do not obtain in both cases? And whether we have not a right to expect and demand the same evidence in both?

Qu. 43. Whether an algebraist, fluxionist, geometrician, or demonstrator of any kind can expect indulgence for obscure principles or incorrect reasonings? And whether an algebraical note or species can, at the end of a process, be interpreted in a sense which could not have been substituted for it at the beginning? Or whether any particular supposition can come under a general case which doth not consist with the reasoning thereof?

Qu. 44. Whether the difference between a mere computer and a man of science be not, that the one computes on principles clearly conceived, and by rules evidently demonstrated, whereas the other doth not?

Qu. 45. Whether, although geometry be a science, and algebra allowed to be a science, and the analytical a most excellent method, in the application nevertheless of the analysis to geometry, men may not have admitted false principles and wrong methods of reasoning?

Qu. 46. Whether, although algebraical reasonings are admitted

to be ever so just, when confined to signs or species, as general representatives of quantity, you may not nevertheless fall into error, if, when you limit them to stand for particular things, you do not limit yourself to reason consistently with the nature of such particular things? And whether such error ought to be imputed to pure algebra?

Qu. 47. Whether the view of modern mathematicians doth not rather seem to be the coming at an expression by artifice, than the coming at science by demonstration?

Qu. 48. Whether there may not be sound metaphysics as well as unsound? Sound as well as unsound logic? And whether the modern analytics may not be brought under one of these denominations, and which?

Qu. 49. Whether there be not really a *philosophia prima*, a certain transcendental science superior to and more extensive than mathematics, which it might behove our modern analysts rather to learn than despise?

Qu. 50. Whether, ever since the recovery of mathematical learning, there have not been perpetual disputes and controversies among the mathematicians? And whether this doth not disparage the evidence of their methods?

Qu. 51. Whether any thing but metaphysics and logic can open the eyes of mathematicians, and extricate them out of their difficulties?

Qu. 52. Whether upon the received principles a quantity can, by any division or subdivision, though carried ever so far, be reduced to nothing?

Qu. 53. Whether, if the end of geometry be practice, and this practice be measuring, and we measure only assignable extensions, it will not follow that unlimited approximations completely answer the intention of geometry?

Qu. 54. Whether the same things which are now done by infinites may not be done by finite quantities? And whether this would not be a great relief to the imaginations and understandings of mathematical men?

Qu. 55. Whether those philomathematical physicians, anatomists, and dealers in the animal economy, who admit the doctrine of fluxions with an implicit faith, can with a good grace insult other men for believing what they do not comprehend?

Qu. 56. Whether the corpuscularian, experimental, and mathematical philosophy, so much cultivated in the last age, hath not too much engrossed men's attention; some part whereof it might have usefully employed?

Qu. 57. Whether from this, and other concurring causes, the minds of speculative men have not been borne downward, to the debasing and stupifying of the higher faculties? And whether we may not hence account for that prevailing narrowness and

bigotry among many who pass for men of science, their incapacity for things moral, intellectual, or theological, their proneness to measure all truths by sense and experience of animal life?

Qu. 58. Whether it be really an effect of thinking, that the same men admire the great author for his fluxions, and deride him for his religion?

Qu. 59. If certain philosophical *virtuosi* of the present age have no religion, whether it can be said to be want of faith?

Qu. 60. Whether it be not a juster way of reasoning, to recommend points of faith from their effects, than to demonstrate mathematical principles by their conclusions?

Qu. 61. Whether it be not less exceptionable to admit points above reason than contrary to reason?

Qu. 62. Whether mysteries may not with better right be allowed of in divine faith, than in human science?

Qu. 63. Whether such mathematicians as cry out against mysteries, have ever examined their own principles?

Qu. 64. Whether mathematicians, who are so delicate in religious points, are strictly scrupulous in their own science? Whether they do not submit to authority, take things upon trust, believe points inconceivable? Whether they have not their mysteries, and what is more, their repugnancies and contradictions?

Qu. 65. Whether it might not become men, who are puzzled and perplexed about their own principles, to judge warily, candidly, and modestly concerning other matters?

Qu. 66. Whether the modern analytics do not furnish a strong *argumentum ad hominem*, against the philomathematical infidels of these times?

Qu. 67. Whether it follows from the above-mentioned remarks, that accurate and just reasoning is the peculiar character of the present age? And whether the modern growth of infidelity can be ascribed to a distinction so truly valuable?

A

DEFENCE OF FREE-THINKING

IN MATHEMATICS.

IN ANSWER TO A PAMPHLET OF PHILALETHES CANTABRIGIENSIS, ENTITLED, GEOMETRY NO FRIEND TO INFIDELITY, OR A DEFENCE OF SIR ISAAC NEWTON AND THE BRITISH MATHEMATICIANS.

ALSO,

AN APPENDIX,

CONCERNING MR. WALTON'S VINDICATION OF THE PRINCIPLES OF FLUXIONS AGAINST THE OBJECTIONS CONTAINED IN THE ANALYST.

Wherein it is attempted to put this controversy in such a light as that every reader may be able to judge thereof.

A DEFENCE OF FREE-THINKING

IN MATHEMATICS, &c.

I. When I read your defence of the British mathematicians, I could not, Sir, but admire your courage in asserting with such undoubting assurance things so easily disproved. This to me seemed unaccountable, till I reflected on what you say (p. 32), when upon my having appealed to every thinking reader, whether it be possible to frame any clear conception of fluxions, you express yourself in the following manner, "Pray Sir, who are those thinking readers you appeal to? Are they geometricians or persons wholly ignorant of geometry? If the former, I leave it to them: if the latter, I ask how well are they qualified to judge of the method of fluxions?" It must be acknowledged you seem by this dilemma secure in the favour of one part of your readers, and the ignorance of the other. I am nevertheless persuaded there are fair and candid men among the mathematicians. And for those who are not mathematicians, I shall endeavour so to unveil this mystery, and put the controversy between us in such a light, as that every reader of ordinary sense and reflection may be a competent judge thereof.

II. You express an extreme surprise and concern, that I should take so much pains to depreciate one of the noblest sciences, to disparage and traduce a set of learned men whose labours so greatly conduce to the honour of this island (p. 5); to lessen the reputation and authority of Sir Isaac Newton and his followers, by showing that they are not such masters of reason as they are generally presumed to be; and to depreciate the science they profess, by demonstrating to the world, that it is not of that clearness and certainty as is commonly imagined. All which, you insist, appears very strange to you and the rest of that famous University, who plainly see of how great use mathematical learning is to mankind. Hence you take occasion to declaim on the usefulness of mathematics in the several branches, and then to redouble your surprise and amazement (p. 19, 20). To all which declamation I reply that it is quite beside the purpose. For I allow, and always have allowed, its full claim of merit to whatever is useful and true in the mathematics: but that which is not so, the less it employs men's time and thoughts,

the better. And after all you have said or can say, I believe the unprejudiced reader will think with me, that things obscure are not therefore sacred; and that it is no more a crime to canvass and detect unsound principles or false reasonings in mathematics, than in any other part of learning.

III. You are, it seems, much at a loss to understand the usefulness, or tendency, or prudence of my attempt. I thought I had sufficiently explained this in the Analyst. But for your further satisfaction shall here tell you, it is very well known, that several persons who deride faith and mysteries in religion, admit the doctrine of fluxions for true and certain. Now if it be shown that fluxions are really most incomprehensible mysteries, and that those, who believe them to be clear and scientific, do entertain an implicit faith in the author of that method; will not this furnish a fair *argumentum ad hominem* against men who reject that very thing in religion which they admit in human learning? And is it not a proper way to abate the pride and discredit the pretensions of those who insist upon clear ideas in points of faith, if it be shown that they do without them even in science?

IV. As to my timing this charge; why now and not before, since I had published hints thereof many years ago? Surely I am obliged to give no account of this: if what hath been said in the Analyst be not sufficient; suppose that I had not leisure, or that I did not think it expedient, or that I had no mind to it. When a man thinks fit to publish any thing, either in mathematics, or in any other part of learning; what avails it, or indeed what right hath any one to ask, why at this or that time; in this or that manner; upon this or that motive? Let the reader judge, if it suffice not that what I publish is true, and that I have a right to publish such truths when and how I please, in a free country.

V. I do not say, that mathematicians, as such, are infidels; or that geometry is a friend to infidelity, which you untruly insinuate, as you do many other things; whence you raise topics for invective: but I say there are certain mathematicians who are known to be so; and that there are others, who are not mathematicians, who are influenced by a regard for their authority. Some perhaps, who live in the university, may not be apprised of this; but the intelligent and observing reader, who lives in the world, and is acquainted with the humour of the times, and the characters of men, is well aware, there are too many that deride mysteries, and yet admire fluxions; who yield that faith to a mere mortal, which they deny to Jesus Christ, whose religion they make it their study and business to discredit. The owning this is not to own that men who reason well are enemies to religion, as you would represent it: on the contrary, I endeavour

to show, that such men are defective in point of reason and judgment, and that they do the very thing they would seem to despise.

VI. There are, I make no doubt, among the mathematicians many sincere believers in Jesus Christ; I know several such myself; but I addressed my Analyst to an infidel; and on very good grounds, I supposed that besides him there were other deriders of faith, who had nevertheless a profound veneration for fluxions; and I was willing to set forth the inconsistence of such men. If there be no such thing as infidels, who pretend to knowledge in the modern analysis, I own myself misinformed, and shall gladly be found in a mistake; but even in that case, my remarks upon fluxions are not the less true; nor will it follow, that I have no right to examine them on the foot of human science, even though religion were quite unconcerned, and though I had no end to serve but truth. But you are very angry (p. 13, 14) that I should enter the lists with reasoning infidels, and attack them upon their pretensions to science: and hence you take occasion to show your spleen against the clergy. I will not take upon me to say, that I know you to be a minute philosopher yourself: but I know, the minute philosophers make just such compliments as you do to our church, and are just as angry as you can be at any who undertake to defend religion by reason. If we resolve all into faith, they laugh at us and our faith: and if we attempt to reason, they are angry at us: they pretend we go out of our province, and they recommend to us a blind, implicit faith. Such is the inconsistence of our adversaries. But it is to be hoped, there will never be wanting men to deal with them at their own weapons; and to show, they are by no means those masters of reason, which they would fain pass for.

VII. I do not say, as you would represent me, that we have no better reason for our religion than you have for fluxions: but I say, that an infidel, who believes the doctrines of fluxions, acts a very inconsistent part, in pretending to reject the Christian religion, because he cannot believe what he doth not comprehend; or because he cannot assent without evidence; or because he cannot submit his faith to authority. Whether there are such infidels, I submit to the judgment of the reader; for my own part, I make no doubt of it, having seen some shrewd signs thereof myself, and having been very credibly informed thereof by others. Nor doth this charge seem the less credible, for your being so sensibly touched, and denying it with so much passion. You, indeed, do not stick to affirm, that the persons who informed me are "a pack of base, profligate, and impudent liars," p. 27. How far the reader will think fit to adopt your passions I cannot say; but I can truly say, the late celebrated Mr. Addison is one of the persons whom you are pleased to characterize in those

modest and mannerly terms. He assured me that the infidelity of a certain noted mathematician, still living, was one principal reason assigned by a witty man of those times for his being an infidel. Not that I imagine geometry disposeth men to infidelity: but that from other causes, such as presumption, ignorance, or vanity, like other men geometricians also become infidels, and that the supposed light and evidence of their science gains credit to their infidelity.

VIII. You reproach me with calumny, detraction, and artifice, p. 15; you "recommend such means as are innocent and just, rather than the criminal method of lessening or detracting from my opponents," ibid.; you accuse me of the *odium theologicum*, the intemperate zeal of divines, that I do *stare super vias antiquas*, p. 13; with much more to the same effect. For all which charge I depend on the reader's candour, that he will not take your word, but read and judge for himself. In which case he will be able to discern (though he should be no mathematician) how passionate and unjust your reproaches are, and how possible it is, for a man to cry out against calumny and practise it in the same breath. Considering how impatient all mankind are when their prejudices are looked into, I do not wonder to see you rail and rage at the rate you do. But if your own imagination be strongly shocked and moved, you cannot therefore conclude, that a sincere endeavour to free a science, so useful and ornamental to human life, from those subtleties, obscurities, and paradoxes which render it inaccessible to most men, will be thought a criminal undertaking by such as are in their right mind. Much less can you hope that an illustrious seminary of learned men, which hath produced so many free-spirited inquirers after truth, will at once enter into your passions and degenerate into a nest of bigots.

IX. I observe upon the inconsistency of certain infidel analysts. I remark some defects in the principles of the modern analysis. I take the liberty decently to dissent from Sir Isaac Newton. I propose some helps to abridge the trouble of mathematical studies and render them more useful. What is there in all this that should make you declaim on the usefulness of practical mathematics? that should move you to cry out "Spain, inquisition, *odium theologicum?*" By what figure of speech do you extend what is said of the modern analysis, to mathematics in general, or what is said of mathematical infidels to all mathematicians, or the confuting an error in science to burning or hanging the authors? But it is nothing new or strange, that men should choose to indulge their passions, rather than quit their opinions, how absurd soever. Hence the frightful visions and tragical uproars of bigoted men, be the subject of their bigotry what it will. A very remarkable instance of this you

give, p. 27, where, upon my having said that a deference to certain mathematical infidels, as I was credibly informed, had been one motive to infidelity, you ask with no small emotion, "For God's sake are we in England or in Spain? Is this the language of a familiar who is whispering an inquisitor?" &c. And the page before you exclaim in the following words: "Let us burn or hang up all the mathematicians in Great Britain, or halloo the mob upon them to tear them to pieces, every mother's son of them, *Tros Rutulusve fuat*, laymen or clergymen, &c. Let us dig up the bodies of Dr. Barrow and Sir Isaac Newton, and burn them under the gallows," &c.

X. The reader need not be a mathematician to see how vain all this tragedy of yours is. And if he be as thoroughly satisfied as I am, that the cause of fluxions cannot be defended by reason, he will be as little surprised as I am to see you betake yourself to the arts of all bigoted men, raising terror and calling in the passions to your assistance. Whether those rhetorical flourishes about the inquisition and the galleys are not quite ridiculous, I leave to be determined by the reader. Who will also judge (though he should not be skilled in geometry) whether I have given the least grounds for this and a world of such like declamation? And whether I have not constantly treated those celebrated writers with all proper respect, though I take the liberty in certain points to differ from them?

XI. As I heartily abhor an inquisition in faith, so I think you have no right to erect one in science. At the time of writing your defence you seem to have been overcome with passion: but now you may be supposed cool, I desire you to reflect whether it be not wrote in the true spirit of an inquisitor. Whether this becomes a person so exceedingly delicate himself upon that point? And whether your brethren the Analysts will think themselves honoured or obliged by you, for having defended their doctrine, in the same manner as any declaiming bigot would defend transubstantiation? The same false colours, the same intemperate sallies, and the same indignation against common sense!

XII. In a matter of mere science, where authority hath nothing to do, you constantly endeavour to overbear me with authorities, and load me with envy. If I see a sophism in the writings of a great author, and, in compliment to his understanding, suspect he could hardly be quite satisfied with his own demonstration: this sets you on declaiming for several pages. It is pompously set forth as a criminal method of detracting from great men, as a concerted project to lessen their reputation, as making them pass for impostors. If I publish my free thoughts, which I have as much right to publish as any other man, it is imputed to rashness and vanity and the love of opposition. Though perhaps my late publication, of what had been hinted twenty-five

years ago, may acquit me of this charge in the eyes of an impartial reader. But when I consider the perplexities that beset a man who undertakes to defend the doctrine of fluxions, I can easily forgive your anger.

XIII. Two sorts of learned men there are: one who candidly seek truth by rational means. These are never averse to have their principles looked into, and examined by the test of reason. Another sort there is who learn by rote a set of principles and a way of thinking which happen to be in vogue. These betray themselves by their anger and surprise whenever their principles are freely canvassed. But you must not expect that your reader will make himself a party to your passions or your prejudices. I freely own that Sir Isaac Newton hath shown himself an extraordinary mathematician, a profound naturalist, a person of the greatest abilities and erudition. Thus far I can readily go, but I cannot go to the lengths that you do. I shall never say of him as you do, *Vestigia pronus adoro* (p. 70). This same adoration that you pay to him I will pay only to truth.

XIV. You may indeed yourself be an idolater of whom you please: but then you have no right to insult and exclaim at other men because they do not adore your idol. Great as Sir Isaac Newton was, I think he hath, on more occasions than one, shown himself not to be infallible. Particularly his demonstration of the doctrine of fluxions I take to be defective, and I cannot help thinking that he was not quite pleased with it himself. And yet this doth not hinder but the method may be useful, considered as an art of invention. You, who are a mathematician, must acknowledge there have been divers such methods admitted in mathematics, which are not demonstrative. Such, for instance, are the inductions of Dr. Wallis in his Arithmetic of Infinites, and such, what Harriot and, after him, Descartes, have wrote concerning the roots of affected equations. It will not, nevertheless, thence follow that those methods are useless; but only, that they are not to be allowed of as premises in a strict demonstration.

XV. No great name upon earth shall ever make me accept things obscure for clear, or sophisms for demonstrations. Nor may you ever hope to deter me from freely speaking what I freely think, by those arguments *ab invidia* which at every turn you employ against me. You represent yourself (p. 52) as a man whose highest ambition is in the lowest degree to imitate Sir Isaac Newton. It might perhaps have suited better with your appellation of Philalethes, and been altogether as laudable, if your highest ambition had been to discover truth. Very consistently with the character you give of yourself, you speak of it as a sort of crime (p. 70) to think it possible you should ever see further, or go beyond Sir Isaac Newton. And I am persuaded

you speak the sentiments of many more besides yourself. But there are others who are not afraid to sift the principles of human science, who think it no honour to imitate the greatest man in his defects, who even think it no crime to desire to know, not only beyond Sir Isaac Newton, but beyond all mankind. And whoever thinks otherwise, I appeal to the reader whether he can properly be called a philosopher.

XVI. Because I am not guilty of your mean idolatry, you inveigh against me as a person conceited of my own abilities; not considering that a person of less abilities may know more on a certain point than one of greater; not considering that a purblind eye, in a close and narrow view, may discern more of a thing than a much better eye in a more extensive prospect; not considering that this is to fix a *ne plus ultra*, to put a stop to all future inquiries; lastly, not considering that this is in fact, so much as in you lies, converting the republic of letters into an absolute monarchy, that it is even introducing a kind of philosophic popery among a free people.

XVII. I have said (and I venture still to say) that a fluxion is incomprehensible: that second, third, and fourth fluxions are yet more incomprehensible: that it is not possible to conceive a simple infinitesimal, that it is yet less possible to conceive an infinitesimal of an infinitesimal, and so onward.* What have you to say in answer to this? Do you attempt to clear up the notion of a fluxion or a difference? Nothing like it; you only assure me (upon your bare word) from your own experience, and that of several others whom you could name, that "the doctrine of fluxions may be clearly conceived and distinctly comprehended; and that if I am puzzled about it and do not understand it, yet others do." But can you think, Sir, I shall take your word when I refuse to take your master's?

XVIII. Upon this point every reader of common sense may judge as well as the most profound mathematician. The simple apprehension of a thing defined is not made more perfect by any subsequent progress in mathematics. What any man evidently knows he knows as well as you or Sir Isaac Newton. And every one can know whether the object of this method be (as you would have us think) clearly conceivable. To judge of this no depth of science is requisite, but only a bare attention to what passes in his own mind. And the same is to be understood of all definitions in all sciences whatsoever. In none of which can it be supposed, that a man of sense and spirit will take any definition or principle upon trust, without sifting it to the bottom, and trying how far he can or he cannot conceive it. This is the course I have taken and shall take, however you and your bre-

* Analyst, sect. iv., v., vi., &c.

thren may declaim against it, and place it in the most invidious light.

XIX. It is usual with you to admonish me to look over a second time, to consult, examine, weigh the words of Sir Isaac. In answer to which I will venture to say that I have taken as much pains as (I sincerely believe) any man living, to understand that great author, and to make sense of his principles. No industry, nor caution, nor attention, I assure you, have been wanting on my part. So that, if I do not understand him, it is not my fault but my misfortune. Upon other subjects you are pleased to compliment me with depth of thought and uncommon abilities (p. 5 and 84). But I freely own I have no pretence to those things. The only advantage I pretend to is, that I have always thought and judged for myself. And, as I never had a master in mathematics, so I fairly followed the dictates of my own mind in examining and censuring the authors I read upon that subject with the same freedom that I used upon any other; taking nothing upon trust, and believing that no writer was infallible. And a man of moderate parts, who takes this painful course in studying the principles of any science, may be supposed to walk more surely than those of greater abilities, who set out with more speed and less care.

XX. What I insist on is, that the idea of a fluxion simply considered is not at all improved or amended by any progress, though ever so great, in the analysis: neither are the demonstrations of the general rules of that method at all cleared up by applying them. The reason of which is, because in operating or calculating, men do not return to contemplate the original principles of the method, which they constantly presuppose, but are employed in working, by notes and symbols, denoting the fluxions supposed to have been at first explained, and according to rules supposed to have been at first demonstrated. This I say to encourage those who are not far gone in these studies, to use intrepidly their own judgment, without a blind or a mean deference to the best of mathematicians, who are no more qualified than they are to judge of the simple apprehension, or the evidence of what is delivered in the first elements of the method; men by further and frequent use or exercise becoming only more accustomed to the symbols and rules, which doth not make either the foregoing notions more clear, or the foregoing proofs more perfect. Every reader of common sense, that will but use his faculties, knows as well as the most profound analyst what idea he frames or can frame of velocity without motion, or of motion without extension, of magnitude which is neither finite nor infinite, or of a quantity having no magnitude which is yet divisible, of a figure where there is no space, of proportion between nothings, or of a real product from nothing multiplied by something. He

need not be far gone in geometry to know, that obscure principles are not to be admitted in demonstration: that if a man destroys his own hypothesis, he at the same time destroys what was built upon it: that error in the premises, not rectified, must produce error in the conclusion.

XXI. In my opinion the greatest men have their prejudices. Men learn the elements of science from others: and every learner hath a deference more or less to authority, especially the young learners, few of that kind caring to dwell long upon principles, but inclining rather to take them upon trust: and things early admitted by repetition become familiar: and this familiarity at length passeth for evidence. Now to me it seems there are certain points tacitly admitted by mathematicians, which are neither evident nor true. And such points or principles ever mixing with their reasonings do lead them into paradoxes and perplexities. If the great author of the fluxionary method was early imbued with such notions, it would only show he was a man. And if by virtue of some latent error in his principles a man be drawn into fallacious reasonings, it is nothing strange that he should take them for true: and, nevertheless, if, when urged by perplexities and uncouth consequences, and driven to arts and shifts, he should entertain some doubt thereof, it is no more than one may naturally suppose might befall a great genius, grappling with an insuperable difficulty: which is the light in which I have placed Sir Isaac Newton.* Hereupon you are pleased to remark, that I represent the great author, not only as a weak, but an ill man, as a deceiver and an impostor. The reader will judge how justly.

XXII. As to the rest of your colourings and glosses, your reproaches, and insults, and outcries, I shall pass them over, only desiring the reader not to take your word, but read what I have written, and he will want no other answer. It hath been often observed, that the worst cause produceth the greatest clamour; and, indeed, you are so clamorous throughout your defence, that the reader, although he should be no mathematician, provided he understands common sense and hath observed the ways of men, will be apt to suspect that you are in the wrong. It should seem, therefore, that your brethren the analysts are but little obliged to you, for this new method of declaiming in mathematics. Whether they are more obliged by your reasoning I shall now examine.

XXIII. You ask me (p. 32) where I find Sir Isaac Newton using such expressions as the velocities of velocities, the second, third, and fourth velocities, &c. This you set forth as a pious fraud and unfair representation. I answer, that if, according to Sir Isaac Newton, a fluxion be the velocity of an increment,

* Analyst, sect. xviii.

then, according to him, I may call the fluxion of a fluxion the velocity of a velocity. But for the truth of the antecedent see his Introduction to the Quadrature of Curves, where his own words are, *Motuum vel incrementorum velocitates nominando fluxiones.* See also the second lemma of the second book of his Mathematical Principles of Natural Philosophy, where he expresseth himself in the following manner, *Velocitates incrementorum ac decrementorum quas etiam, motus, mutationes, et fluxiones quantitatum nominare licet.* And that he admits fluxions of fluxions, or second, third, fourth fluxions, &c.; see his Treatise of the Quadrature of Curves. I ask now, is it not plain, that if a fluxion be a velocity, then the fluxion of a fluxion may agreeably thereunto be called the velocity of a velocity? In like manner, if by a fluxion is meant a nascent augment, will it not then follow, that the fluxion of a fluxion, or second fluxion, is the nascent augment of a nascent augment? Can any thing be plainer. Let the reader now judge who is unfair.

XXIV. I had observed, that the great author had proceeded illegitimately, in obtaining the fluxion or moment of the rectangle of two flowing quantities; and that he did not fairly get rid of the rectangle of the moments. In answer to this you allege, that the error arising from the omission of such rectangle (allowing it to be an error) is so small that it is insignificant. This you dwell upon, and exemplify to no other purpose but to amuse your reader and mislead him from the question; which, in truth, is not concerning the accuracy of computing or measuring in practice, but concerning the accuracy of the reasoning in science. That this was really the case, and that the smallness of the practical error no wise concerns it, must be so plain to any one who reads the Analyst, that I wonder how you could be ignorant of it.

XXV. You would fain persuade your reader, that I make an absurd quarrel against errors of no significancy in practice, and represent mathematicians as proceeding blindfold in their approximations, in all which I cannot help thinking there is, on your part, either great ignorance or great disingenuity. If you mean to defend the reasonableness and use of approximations, or of the method of indivisibles, I have nothing to say. But then you must remember this is not the doctrine of fluxions: it is none of that analysis with which I am concerned. That I am far from quarrelling at approximations in geometry, is manifest from the thirty-third and fifty-third queries in the Analyst. And that the method of fluxions pretends to somewhat more than the method of indivisibles is plain; because Sir Isaac disclaims this method as not geometrical.* And that the method

* See the scholium at the end of the first section. Lib. i. Phil. Nat. Prin. Math.

of fluxions is supposed accurate in geometrical rigour is manifest, to whoever considers what the great author writes about it; especially in his introduction to the Quadrature of Curves, where he saith, "In rebus mathematicis errores quam minimi non sunt contemnendi." Which expression you have seen quoted in the Analyst, and yet you seem ignorant thereof, and, indeed, of the very end and design of the great author in this his invention of fluxions.

XXVI. As oft as you talk of finite quantities inconsiderable in practice, Sir Isaac disowns your apology. *Cave*, saith he, *intellexeris finitas*. And although quantities less than sensible may be of no account in practice, yet none of your masters, nor will even you yourself, venture to say, they are of no account in theory and in reasoning. The application in gross practice is not the point questioned, but the rigour and justness of the reasoning. And it is evident, that be the subject ever so little, or ever so inconsiderable, this doth not hinder but that a person treating thereof may commit very great errors in logic, which logical errors are in no wise to be measured by the sensible or practical inconveniences thence arising, which, perchance, may be none at all. It must be owned, that after you have misled and amused your less qualified reader (as you call him), you return to the real point in controversy, and set yourself to justify Sir Isaac's method of getting rid of the above-mentioned rectangle. And here I must entreat the reader to observe how fairly you proceed.

XXVII. First then you affirm (p. 44), "that, neither in the demonstration of the rule for finding the fluxion of the rectangle of two flowing quantities, nor in any thing preceding or following it, is any mention, so much as once, made of the increment of the rectangle of such flowing quantities." Now I affirm the direct contrary. For in the very passage by you quoted in this same page, from the first case of the second lemma of the second book of Sir Isaac's principles, beginning with "Rectangulum quodvis motu perpetuo auctum," and ending with "igitur laterum incrementis totis a et b, generatur rectanguli incrementum a B x b A. Q. E. D." In this very passage I say, is express mention made of the increment of such rectangle. As this is matter of fact, I refer it to the reader's own eyes. Of what rectangle have we here the increment? Is it not plainly of that whose sides have a and b for their *incrementa tota*, that is, of A B. Let any reader judge whether it be not plain from the words, the sense, and the context, that the great author in the end of his demonstration understands his *incrementum* as belonging to the *rectangulum quodvis* at the beginning. Is not the same also evident from the very lemma itself prefixed to the demonstration? The sense whereof is, (as the author there

explains it,) that if the moments of the flowing quantities A and B are called *a* and *b*, then the *momentum vel mutatio geniti rectanguli* A B will be *a* B x *b* A. Either therefore the conclusion of the demonstration is not the thing which was to be demonstrated, or the *rectanguli incrementum a* B x *b* A belongs to the rectangle A B.

XXVIII. All this is so plain that nothing can be more so; and yet you would fain perplex this plain case by distinguishing between an increment and a moment. But it is evident to every one, who has any notion of demonstration, that the *incrementum* in the conclusion must be the *momentum* in the lemma; and to suppose it otherwise is no credit to the author. It is in effect supposing him to be one who did not know what he would demonstrate. But let us hear Sir Isaac's own words: *Earum (quantitatum scilicet fluentium) incrementa vel decrementa momentanea sub nomine momentorum intelligo.* And you observe yourself that he useth the word *moment* to signify either an increment or decrement. Hence with an intention to puzzle me, you propose the increment and decrement of A B, and ask which of these I would call the moment? The case, you say, is difficult. My answer is very plain and easy, to wit, either of them. You, indeed, make a different answer, and from the author's saying that by a moment he understands either the momentaneous increment or decrement of the flowing quantities, you would have us conclude, by a very wonderful inference, that his moment is neither the increment nor decrement thereof. Would it not be as good an inference, because a number is either odd or even, to conclude it is neither? Can any one make sense of this? Or can even yourself hope that this will go down with the reader, how little soever qualified? It must be owned, you endeavour to obtrude this inference on him, rather by mirth and humour than by reasoning. You are merry, I say, and (p. 46) represent the two mathematical quantities as pleading their rights, as tossing up cross and pile, as disputing amicably. You talk of their claiming preference, their agreeing, their boyishness, and their gravity. And after this ingenious digression you address me in the following words: "Believe me there is no remedy, you must acquiesce." But my answer is that I will neither believe you nor acquiesce; there is a plain remedy in common sense; and that to prevent surprise I desire the reader always to keep the controverted point in view, to examine your reasons, and be cautious how he takes your word, but most of all when you are positive, or eloquent, or merry.

XXIX. A page or two after, you very candidly represent your case to be that of an ass between two bottles of hay: it is your own expression. The cause of your perplexity is that you know not whether the velocity of A B increasing or of A B

decreasing is to be esteemed the fluxion, or proportional to the moment of the rectangle. My opinion, agreeably to what hath been premised, is that either may be deemed the fluxion. But you tell us (p. 49) "that you think, the venerable ghost of Sir Isaac Newton whispers you, the velocity you seek for is neither the one nor the other of these, but is the velocity which the flowing rectangle hath, not while it is greater or less than A B, but at that very instant of time that it is A B." For my part, in the rectangle A B considered simply in itself, without either increasing or diminishing, I can conceive no velocity at all. And if the reader is of my mind, he will not take either your word, or even the word of a ghost how venerable soever, for velocity without motion. You proceed and tell us that, in like manner, the moment of the rectangle is neither its increment or decrement. This you would have us believe on the authority of his ghost, in direct opposition to what Sir Isaac himself asserted when alive. *Incrementa* (saith he) *vel decrementa momentanea sub nomine momentorum intelligo: ita ut incrementa pro momentis addititiis seu affirmativis, ac decrementa pro subductitiis seu negativis abeantur.** I will not, in your style, bid the reader believe me, but believe his eyes.

XXX. To me it verily seems, that you have undertaken the defence of what you do not understand. To mend the matter, you say, "you do not consider A B as lying at either extremity of the moment, but as extended to the middle of it; as having acquired the one half of the moment, as being about to acquire the other; or as having lost one half of it, and being about to lose the other." Now, in the name of truth, I entreat you to tell what this moment is, to the middle whereof the rectangle is extended? This moment, I say, which is acquired, which is lost, which is cut in two, or distinguished into halves? Is it a finite quantity, or an infinitesimal, or a mere limit, or nothing at all? Take it in what sense you will, I cannot make your defence either consistent or intelligible. For if you take it in either of the two former senses, you contradict Sir Isaac Newton. And if you take it in either of the latter, you contradict common sense; it being plain, that what hath no magnitude, or is no quantity, cannot be divided. And here I must entreat the reader to preserve his full freedom of mind entire, and not weakly suffer his judgment to be overborne by your imagination and your prejudices, by great names and authorities, by ghosts and visions, and above all by that extreme satisfaction and complacency with which you utter your strange conceits; if words without a meaning may be called so. After having given this unintelligible account, you ask with your accustomed air, "What say you, sir?

* Princip. Phil. Nat., lib. ii. lem. ii.

Is this a just and legitimate reason for Sir Isaac's proceeding as he did? I think you must acknowledge it to be so." But alas! I acknowledge no such thing. I find no sense or reason in what you say. Let the reader find it if he can.

XXXI. In the next place (p. 50) you charge me with want of caution. "Inasmuch (say you) as that quantity which Sir Isaac Newton, through his whole lemma, and all the several cases of it, constantly calls a *moment*, without confining it to be either an increment or decrement, is by you inconsiderately and arbitrarily, and without any shadow of reason given, supposed and determined to be an increment." To which charge I reply that it is as untrue as it is peremptory. For that, in the foregoing citation from the first case of Sir Isaac's lemma, he expressly determines it to be an increment. And as this particular instance or passage was that which I objected to, it was reasonable and proper for me to consider the moment in that same light. But take it increment or decrement as you will, the objections still lie, and the difficulties are equally insuperable. You then proceed to extol the great author of the fluxionary method, and to bestow some *brusqueries* upon those who unadvisedly dare to differ from him. To all which I shall give no answer.

XXXII. Afterwards to remove (as you say) all scruple and difficulty about this affair, you observe that the moment of the rectangle determined by Sir Isaac Newton, and the increment of the rectangle determined by me, are perfectly and exactly equal, supposing a and b to be diminished *ad infinitum*: and for proof of this, you refer to the first lemma of the first section of the first book of Sir Isaac's principles. I answer, that if a and b are real quantities, then $a\,b$ is something, and consequently makes a real difference: but if they are nothing, then the rectangles whereof they are coefficients become nothing likewise: and consequently the *momentum* or *incrementum*, whether Sir Isaac's or mine, are in that case nothing at all. As for the above-mentioned lemma, which you refer to, and which you wish I had consulted sooner, both for my own sake and for yours; I tell you I had long since consulted and considered it. But I very much doubt whether you have sufficiently considered that lemma, its demonstration and its consequences. For, however that way of reasoning may do in the method of exhaustions, where quantities less than assignable are regarded as nothing; yet for a fluxionist writing about momentums, to argue that quantities must be equal because they have no assignable difference, seems the most injudicious step that could be taken: it is directly demolishing the very doctrine you would defend. For it will thence follow, that all homogeneous momentums are equal, and consequently the velocities, mutations, or fluxions proportional thereto, are all likewise equal. There is, therefore, only one proportion of equality

throughout, which at once overthrows the whole system you undertake to defend. Your moments, I say, not being themselves assignable quantities, their differences cannot be assignable: and if this be true, by that way of reasoning it will follow, they are all equal, upon which supposition you cannot make one step in the method of fluxions. It appears from hence, how unjustly you blame me (p. 32) for omitting to give any account of that first section of the first book of the Principia, wherein (you say) the foundation of the method of fluxions is geometrically demonstrated and largely explained, and difficulties and objections against it are clearly solved. All which is so far from being true, that the very first and fundamental lemma of that section is incompatible with, and subversive of the doctrine of fluxions. And, indeed, who sees not that a demonstration *ad absurdum more veterum*, proceeding on a supposition that every difference must be some given quantity, cannot be admitted in, or consist with, a method wherein quantities, less than any given, are supposed really to exist, and be capable of division?

XXXIII. The next point you undertake to defend is that method for obtaining a rule to find the fluxion of any power of a flowing quantity, which is delivered in his introduction to the Quadratures, and considered in the Analyst.* And here the question between us is, whether I have rightly represented the sense of those words, *evanescant jam augmenta illa*, in rendering them, "let the increments vanish," i. e. let the increments be nothing, or let there be no increments. This you deny, but, as your manner is, instead of giving a reason you declaim. I, on the contrary, affirm, the increments must be understood to be quite gone and absolutely nothing at all. My reason is, because without that supposition you can never bring the quantity or expression $n\,x^{n-1} + \frac{nn-n}{2}\,o\,x^{n-2}$ + &c., down to $n\,x^{n-1}$, the very thing aimed at by supposing the evanescence. Say whether this be not the truth of the case? Whether the former expression is not to be reduced to the latter? And whether this can possibly be done so long as o is supposed a real quantity? I cannot indeed say you are scrupulous about your affirmations, and yet I believe that even you will not affirm this; it being most evident, that the product of two real quantities is something real; and that nothing real can be rejected either according to the ἀκρίβεια of geometry, or according to Sir Isaac's own principles; for the truth of which I appeal to all who know any thing of these matters. Further, by *evanescant* must either be meant let them (the increments) vanish and become nothing, in the obvious sense, or else let them become infinitely small. But

* Sect. xiii. xiv., &c.

that this latter is not Sir Isaac's sense is evident from his own words in the very same page, that is, in the last of his introduction to the Quadratures, where he expressly saith, *Volui ostendere quod in methodo fluxionum non opus sit figuras infinite parvas in geometriam introducere.* Upon the whole, you seem to have considered this affair so very superficially, as greatly to confirm me in the opinion you are so angry with, to wit, that Sir Isaac's followers are much more eager in applying his method, than accurate in examining his principles. You raise a dust about evanescent augments which may perhaps amuse and amaze your reader, but I am much mistaken if it ever instructs or enlightens him. For, to come to the point, those evanescent augments either are real quantities, or they are not. If you say they are; I desire to know, how you get rid of the rejectaneous quantity? If you say they are not, you indeed get rid of those quantities in the composition whereof they are coefficients; but then you are of the same opinion with me, which opinion you are pleased to call (p. 58) a most palpable, inexcusable, and unpardonable blunder, although it be a truth most palpably evident.

XXXIV. Nothing, I say, can be plainer to any impartial reader, than that by the evanescence of augments, in the above cited passage, Sir Isaac means their being actually reduced to nothing. But to put it out of all doubt, that this is the truth, and to convince even you, who show so little disposition to be convinced, I desire you to look into his *Analysis per Æquationes Infinitas*, p. 20, where, in his preparation for demonstrating the first rule for the squaring of simple curves, you will find that on a parallel occasion, speaking of an augment which is supposed to vanish, he interprets the word *evanescere* by *esse nihil.* Nothing can be plainer than this, which at once destroys your defence. And yet, plain as it is, I despair of making you acknowledge it; though I am sure you feel it, and the reader, if he useth his eyes, must see it. The words *evanescere sive esse nihil* do (to use your own expression) stare us in the face. Lo! this is what you call (p. 56), "so great, so unaccountable, so horrid, so truly Bœotian a blunder," that, according to you, it was not possible Sir Isaac Newton could be guilty of it. For the future, I advise you to be more sparing of hard words: since, as you incautiously deal them about, they may chance to light on your friends as well as your adversaries. As for my part, I shall not retaliate. It is sufficient to say you are mistaken. But I can easily pardon your mistakes. Though, indeed, you tell me on this very occasion, that I must expect no quarter from Sir Isaac's followers. And I tell you that I neither expect nor desire any. My aim is truth. My reasons I have given. Confute them, if you can. But think not to overbear me either with authorities or harsh words. The latter will recoil upon yourselves: the former, in a matter of science, are

of no weight with indifferent readers; and as for bigots, I am not concerned about what they say or think.

XXXV. In the next place you proceed to declaim upon the following passage taken from the seventeenth section of the Analyst. "Considering the various arts and devices used by the great author of the fluxionary method: in how many lights he placeth his fluxions: and in what different ways he attempts to demonstrate the same point: one would be inclined to think, he was himself suspicious of the justness of his own demonstrations." This passage you complain of as very hard usage of Sir Isaac Newton. You declaim copiously, and endeavour to show that placing the same point in various lights is of great use to explain it; which you illustrate with much rhetoric. But the fault of that passage is not the hard usage it contains: but on the contrary, that it is too modest, and not so full and expressive of my sense, as perhaps it should have been. Would you like it better if I should say, the various inconsistent accounts, which this great author gives of his momentums and his fluxions, may convince every intelligent reader that he had no clear and steady notions of them, without which there can be no demonstration? I own frankly that I see no clearness or consistence in them. You tell me indeed, in Miltonic verse, that the fault is in my own eyes,

> So thick a drop serene has quenched their orbs,
> Or dim suffusion veiled;

at the same time you acknowledge yourself obliged for those various lights, which have enabled you to understand his doctrine. But as for me, who do not understand it, you insult me, saying, "For God's sake what is it you are offended at, who do not still understand him?" May not I answer, that I am offended for this very reason; because I cannot understand him or make sense of what he says? You say to me, that I am all in the dark. I acknowledge it, and entreat you, who see so clearly, to help me out.

XXXVI. You, Sir, with the bright eyes, be pleased to tell me, whether Sir Isaac's momentum be a finite quantity, or an infinitesimal, or a mere limit? If you say a finite quantity: be pleased to reconcile this with what he saith in the scholium of the second lemma of the first section of the first book of his Principles; "Cave intelligas quantitates magnitudine determinatas, sed cogita semper diminuendas sine limite." If you say, an infinitesimal: reconcile this with what is said in his introduction to the Quadratures: "Volui ostendere quod in methodo fluxionum non opus sit figuras infinite parvas in geometriam inducere." If you should say, it is a mere limit, be pleased to reconcile this with what we find in the first case of the second lemma in the second book of his principles: "Ubi de lateribus A et B deerant momentorum

dimidia," &c., where the moments are supposed to be divided. I should be very glad, a person of such a luminous intellect would be so good as to explain, whether by fluxions we are to understand the nascent or evanescent quantities themselves, or their motions, or their velocities, or simply their proportions; and having interpreted them in what sense you will, that you would then condescend to explain the doctrine of second, third, and fourth fluxions, and show it to be consistent with common sense if you can. You seem to be very sanguine when you express yourself in the following terms. "I do assure you, Sir, from my own experience, and that of many others whom I could name, that the doctrine may be clearly conceived and distinctly comprehended," p. 31. And it may be uncivil not to believe what you so solemnly affirm, from your own experience. But I must needs own, I should be better satisfied of this, if, instead of entertaining us with your rhetoric, you would vouchsafe to reconcile those difficulties, and explain those obscure points above mentioned. If either you, or any one of those many whom you could name, will but explain to others what you so clearly conceive yourselves, I give you my word that several will be obliged to you, who, I may venture to say, understand those matters no more than myself. But, if I am not much mistaken, you and your friends will modestly decline this task.

XXXVII. I have long ago done what you so often exhort me to do, diligently read and considered the several accounts of this doctrine given by the great author in different parts of his writings: and upon the whole I could never make it out to be consistent and intelligible. I was even led to say, "that one would be inclined to think, he was himself suspicious of the justness of his own demonstrations: and that he was not enough pleased with any one notion steadily to adhere to it." After which I added, "Thus much is plain, that he owned himself satisfied concerning certain points, which nevertheless he could not undertake to demonstrate to others." See the seventeenth section of the Analyst. It is one thing when a doctrine is placed in various lights: and another, when the principles and notions are shifted. When new devices are introduced and substituted for others, a doctrine, instead of being illustrated, may be explained away. Whether there be not something of this in the present case I appeal to the writings of the great author. His *methodus rationum primarum et ultimarum*, his second lemma in the second book of his principles, his introduction and treatise of the quadrature of curves. In all which, it appears to me, there is not one uniform doctrine explained and carried throughout the whole, but rather sundry inconsistent accounts of this new method, which still grows more dark and confused the more it is handled: I could not help thinking, the greatest genius might lie

under the influence of false principles; and where the object and notions were exceeding obscure, he might possibly distrust even his own demonstrations. "At least thus much seemed plain, that Sir Isaac had sometime owned himself satisfied, where he could not demonstrate to others;" in proof whereof I mentioned his letter to Mr. Collins. Hereupon you tell me, "there is a great deal of difference between saying, I cannot undertake to prove a thing, and I will not undertake it." But in answer to this, I desire you will be pleased to consider, that I was not making a precise extract out of that letter, in which the very words of Sir Isaac should alone be inserted. But I made my own remark and inference, from what I remembered to have read in that letter; where, speaking of a certain mathematical matter, Sir Isaac expresseth himself in the following terms. "It is plain to me by the fountain I draw it from, though I will not undertake to prove it to others." Now whether my inference may not be fairly drawn from those words of Sir Isaac Newton; and whether the difference as to the sense be so great between *will* and *can* in that particular case, I leave to be determined by the reader.

XXXVIII. In the next paragraph you talk big but prove nothing. You speak of driving out of entrenchments, of sallying and attacking and carrying by assault; of slight and untenable works, of a new-raised and undisciplined militia, and of veteran regular troops. Need the reader be a mathematician to see the vanity of this paragraph? After this you employ (p. 65) your usual colouring, and represent the great author of the method of fluxions "as a good old gentleman fast asleep, and snoring in his easy chair; while dame Fortune is bringing him her apron full of beautiful theorems and problems, which he never knows or thinks of." This you would have pass for a consequence of my notions. But I appeal to all those who are ever so little knowing in such matters, whether there are not divers fountains of experiment, induction, and analogy, whence a man may derive and satisfy himself concerning the truth of many points in mathematics and mechanical philosophy, although the proofs thereof afforded by the modern analysis should not amount to demonstration? I further appeal to the conscience of all the most profound mathematicians, whether they can, with perfect acquiescence of mind, free from all scruple, apply any proposition merely upon the strength of a demonstration involving second or third fluxions, without the aid of any such experiment or analogy or collateral proof whatsoever? Lastly, I appeal to the reader's own heart, whether he cannot clearly conceive a medium between being fast asleep and demonstrating? But you will have it, that I represent Sir Isaac's conclusions as coming out right, because one error is compensated by another contrary and equal error, which perhaps he never knew himself nor thought of: that by a twofold

mistake he arrives, though not at science, yet at truth: that he proceeds blindfold, &c. All which is untruly said by you, who have misapplied to Sir Isaac what was intended for the Marquis de l'Hospital and his followers, for no other end (as I can see) but that you may have an opportunity to draw that ingenious portraiture of Sir Isaac Newton and dame Fortune, as will be manifest to whoever reads the Analyst.

XXXIX. You tell me, p. 70, if I think fit to persist in asserting, "that this affair of a double error is entirely a new discovery of my own, which Sir Isaac and his followers never knew nor thought of, that you have unquestionable evidence to convince me of the contrary, and that all his followers are already apprised, that this very objection of mine was long since foreseen, and clearly and fully removed by Sir Isaac Newton in the first section of the first book of his *Principia*." All which I do as strongly deny as you affirm. And I do aver, that this is an unquestionable proof of the matchless contempt which you, Philalethes, have for truth. And I do here publicly call upon you, to produce that evidence which you pretend to have, and to make good that fact which you so confidently affirm. And, at the same time, I do assure the reader that you never will, nor can.

XL. If you defend Sir Isaac's notions as delivered in his *Principia*, it must be on the rigorous foot of rejecting nothing, neither admitting nor casting away infinitely small quantities. If you defend the Marquis, whom you also style your master, it must be on the foot of admitting that there are infinitesimals, that they may be rejected, that they are nevertheless real quantities, and themselves infinitely subdivisible. But you seem to have grown giddy with passion, and in the heat of controversy to have mistaken and forgot your part. I beseech you, Sir, to consider, that the Marquis (whom alone, and not Sir Isaac, this double error in finding the subtangent doth concern) rejects indeed infinitesimals, but not on the foot that you do, to wit, their being inconsiderable in practical geometry or mixed mathematics. But he rejects them in the accuracy of speculative knowledge: in which respect there may be great logical errors, although there should be no sensible mistake in practice: which, it seems, is what you cannot comprehend. He rejects them likewise in virtue of a postulatum, which I venture to call rejecting them without ceremony. And though he inferreth a conclusion accurately true, yet he doth it, contrary to the rules of logic, from inaccurate and false premises. And how this comes about, I have at large explained in the Analyst, and shown, in that particular case of tangents, that the rejectaneous quantity might have been a finite quantity of any given magnitude, and yet the conclusion have come out exactly the same way; and consequently, that the truth of this method doth not depend on the reason assigned by the

Marquis, to wit, the postulatum for throwing away infinitesimals; and therefore that he and his followers acted blindfold, as not knowing the true reason for the conclusions coming out accurately right, which I show to have been the effect of a double error.

XLI. This is the truth of the matter, which you shamefully misrepresent and declaim upon, to no sort of purpose but to amuse and mislead your reader. For which conduct of yours throughout your remarks, you will pardon me if I cannot otherwise account, than from a secret hope, that the reader of your defence would never read the Analyst. If he doth, he cannot but see what an admirable method you take to defend your cause: how, instead of justifying the reasoning, the logic, or the theory of the case specified, which is the real point, you discourse of sensible and practical errors: and how all this is a manifest imposition upon the reader. He must needs see that I have expressly said, "I have no controversy except only about your logic and method: that I consider how you demonstrate; what objects you are conversant about; and whether you conceive them clearly? That I have often expressed myself to the same effect, desiring the reader to remember, that I am only concerned about the way of coming at your theorems, whether it be legitimate or illegitimate, clear or obscure, scientific or tentative: that I have on this very occasion, to prevent all possibility of mistake, repeated and insisted, that I consider the geometrical analyst as a logician, i. e. so far forth as he reasons and argues; and his mathematical conclusions, not in themselves, but in their premises; not as true or false, useful or insignificant, but as derived from such principles, and by such inferences."* You affirm (and indeed what can you not affirm?) that the difference between the true subtangent and that found without any compensation is absolutely nothing at all. I profess myself of a contrary opinion. My reason is, because nothing cannot be divided into parts. But this difference is capable of being divided into any, or into more than any given number of parts; for the truth of which consult the Marquis de l'Hospital. And, be the error in fact or in practice ever so small, it will not thence follow that the error in reasoning, which is what I am alone concerned about, is one whit the less, it being evident that a man may reason most absurdly about the minutest things.

XLII. Pray answer me fairly, once for all, whether it be your opinion, that whatsoever is little and inconsiderable enough to be rejected without inconvenience in practice, the same may, in like manner, be safely rejected and overlooked in theory and demonstration. If you say no, it will then follow, that all you have been saying here and elsewhere, about yards, and inches,

* Analyst, sect. xx.

and decimal fractions, setting forth and insisting on the extreme smallness of the rejectaneous quantity, is quite foreign to the argument, and only a piece of skill to impose upon your reader. If you say yes, it follows that you then give up at once all the orders of fluxions and infinitesimal differences; and so most imprudently turn all your sallies, and attacks, and veterans, to your own overthrow. If the reader is of my mind, he will despair of ever seeing you get clear of this dilemma. The points in controversy have been so often and so distinctly noted in the Analyst, that I very much wonder how you could mistake if you had no mind to mistake. It is very plain, if you are in earnest, that you neither understand me nor your masters. And what shall we think of other ordinary analysts, when it shall be found that even you, who, like a champion, step forth to defend their principles, have not considered them.

XLIII. The impartial reader is entreated to remark, throughout your whole performance, how confident you are in asserting, and withal how modest in proving or explaining: how frequent it is with you to employ figures and tropes instead of reasons: how many difficulties proposed in the Analyst are discreetly overlooked by you, and what strange work you make with the rest; how grossly you mistake and misrepresent, and how little you practise the advice which you so liberally bestow. Believe me, sir, I had long and maturely considered the principles of the modern analysis, before I ventured to publish my thoughts thereupon in the Analyst. And since the publication thereof, I have myself freely conversed with mathematicians of all ranks, and some of the ablest professors, as well as made it my business to be informed of the opinions of others, being very desirous to hear what could be said towards clearing my difficulties or answering my objections. But though you are not afraid or ashamed to represent the analysts as very clear and uniform in their conception of these matters, yet I do solemnly affirm (and several of themselves know it to be true), that I found no harmony or agreement among them, but the reverse thereof, the greatest dissonance and even contrariety of opinions, employed to explain what, after all, seemed inexplicable.

XLIV. Some fly to proportions between nothings. Some reject quantities because infinitesimal. Others allow only finite quantities, and reject them because inconsiderable. Others place the method of fluxions on a foot with that of exhaustions, and admit nothing new therein. Some maintain the clear conception of fluxions. Others hold they can demonstrate about things incomprehensible. Some would prove the algorism of fluxions by *reductio ad absurdum;* others *à priori.* Some hold the evanescent increments to be real quantities, some to be nothings, some to be limits. As many men, so many minds:

each differing one from another, and all from Sir Isaac Newton. Some plead inaccurate expressions in the great author, whereby they would draw him to speak their sense, not considering that if he meant as they do, he could not want words to express his meaning. Others are magisterial and positive, say they are satisfied, and that is all, not considering that we, who deny Sir Isaac Newton's authority, shall not submit to that of his disciples. Some insist that the conclusions are true, and therefore the principles, not considering what hath been largely said in the Analyst * on that head. Lastly, several (and those none of the meanest) frankly owned the objections to be unanswerable. All which I mention by way of antidote to your false colours: and that the unprejudiced inquirer after truth may see, it is not without foundation, that I call on the celebrated mathematicians of the present age to clear up these obscure analytics, and concur in giving to the public some consistent and intelligible account of the principles of their great master: which, if they do not, I believe the world will take it for granted that they cannot.

XLV. Having gone through your defence of the British mathematicians, I find in the next place, that you attack me on a point of metaphysics, with what success the reader will determine. I had upon another occasion, many years ago, wrote against abstract general ideas.† In opposition to which, you declare yourself to adhere to the vulgar opinion, that neither geometry, nor any other general science, can subsist without general ideas (p. 74). This implies that I hold there are no general ideas. But I hold the direct contrary, that there are indeed general ideas, but not formed by abstraction in the manner set forth by Mr. Locke. To me it is plain, there is no consistent idea, the likeness whereof may not really exist: whatsoever therefore is said to be somewhat which cannot exist, the idea thereof must be inconsistent. Mr. Locke acknowledgeth it doth require pains and skill to form his general idea of a triangle. He further expressly saith, it must be neither oblique nor rectangular, neither equilateral, equicrural, nor scalenum; but all and none of these at once. He also saith, it is an idea wherein some parts of several different and inconsistent ideas are put together.‡ All this looks very like a contradiction. But to put the matter past dispute, it must be noted, that he affirms it to be somewhat imperfect that cannot exist; consequently the idea thereof is impossible or inconsistent.

XLVI. I desire to know, whether it is not possible for any thing to exist, which doth not include a contradiction: and if it is, whether we may not infer, that what cannot possibly exist,

* Sect. xix., xx., &c.

† Introduction to the Treatise concerning the Principles of Human Knowledge.

‡ Essay on Human Understanding, b. iv. c. vii. sect. 9.

the same doth include a contradiction: I further desire to know, whether the reader can frame a distinct idea of any thing that includes a contradiction? For my part, I cannot, nor consequently of the above-mentioned triangle; though you (who, it seems, know better than myself what I can do) are pleased to assure me of the contrary. Again, I ask whether that, which it is above the power of man to form a complete idea of, may not be called incomprehensible? And whether the reader can frame a complete idea of this imperfect impossible triangle? And if not, whether it doth not follow that it is incomprehensible? It should seem, that a distinct aggregate of a few consistent parts was nothing so difficult to conceive or impossible to exist; and that, therefore, your comment must be wide of the author's meaning. You give me to understand (p. 82) that this account of a general triangle was a trap which Mr. Locke set to catch fools. Who is caught therein let the reader judge.

XLVII. It is Mr. Locke's opinion, that every general name stands for a general abstract idea, which prescinds from the species or individuals comprehended under it. Thus, for example, according to him, the general name *colour* stands for an idea, which is neither blue, red, green, nor any other particular colour, but somewhat distinct and abstracted from them all. To me it seems, the word *colour* is only a more general name applicable to all and each of the particular colours; while the other specific names, as blue, red, green, and the like, are each restrained to a more limited signification. The same may be said of the word triangle. Let the reader judge whether this be not the case; and whether he can distinctly frame such an idea of colour as shall prescind from all the species thereof, or of a triangle which shall answer Mr. Locke's account, prescinding and abstracting from all the particular sorts of triangles, in the manner aforesaid.

XLVIII. I entreat my reader to think. For if he doth not, he may be under some influence from your confident and positive way of talking. But any one who thinks may, if I mistake not, plainly perceive that you are deluded, as it often happens, by mistaking the terms for ideas. Nothing is easier, than to define in terms or words that which is incomprehensible in idea, forasmuch as any words can be either separated or joined as you please, but ideas always cannot. It is as easy to say a round square as an oblong square, though the former be inconceivable. If the reader will but take a little care to distinguish between the definition and the idea, between words or expressions and the conceptions of the mind, he will judge of the truth of what I now advance, and clearly perceive how far you are mistaken, in attempting to illustrate Mr. Locke's doctrine, and where your mistake lies. Or, if the reader is minded to make a short work, he needs only at once to try whether, laying aside the words, he

can frame in his mind the idea of an impossible triangle; upon which trial the issue of this dispute may be fairly put. This doctrine of abstract general ideas seemed to me a capital error, productive of numberless difficulties and disputes, that runs not only throughout Mr. Locke's book, but through most parts of learning. Consequently, my animadversions thereupon were not an effect of being inclined to carp or cavil at a single passage, as you would wrongfully insinuate, but proceeded from a love of truth, and a desire to banish, so far as in me lay, false principles and wrong ways of thinking, without respect of persons. And indeed, though you and other party men are violently attached to your respective masters, yet I, who profess myself only attached to truth, see no reason why I may not as freely animadvert on Mr. Locke or Sir Isaac Newton, as they would on Aristotle or Descartes. Certainly the more extensive the influence of any error, and the greater the authority which supports it, the more it deserves to be considered and detected by sincere inquirers after knowledge.

XLIX. In the close of your performance, you let me understand, that your zeal for truth and the reputation of your masters hath occasioned your reprehending me with the utmost freedom. And it must be owned you have shown a singular talent therein. But I am comforted under the severity of your reprehensions, when I consider the weakness of your arguments, which, were they as strong as your reproofs, could leave no doubt in the mind of the reader concerning the matters in dispute between us. As it is, I leave him to reflect and examine by your light, how clearly he is enabled to conceive a fluxion, or the fluxion of a fluxion, a part infinitely small subdivided into an infinity of parts, a nascent or evanescent increment, that which is neither something nor nothing, a triangle formed in a point, velocity without motion, and the rest of those *arcana* of the modern analysis. To conclude, I had some thoughts of advising you how to conduct yourself for the future, in return for the advice you have so freely imparted to me: but, as you think it becomes me rather to inform myself than instruct others, I shall, for my further information, take leave to propose a few queries to those learned gentlemen of Cambridge whom you associate with yourself, and represent as being equally surprised at the tendency of my Analyst.

L. I desire to know, whether those who can neither demonstrate nor conceive the principles of the modern analysis, and yet give in to it, may not be justly said to have faith, and be styled believers of mysteries? Whether it is impossible to find among the physicians, mechanical philosophers, mathematicians, and philomathematicians of the present age, some such believers, who yet deride Christians for their belief of mysteries? Whether with such men it is not a fair, reasonable, and legitimate

method to use the *argumentum ad hominem*? And being so, whether it ought to surprise either Christians or scholars? Whether in an age wherein so many pretenders to science attack the Christian religion, we may not be allowed to make reprisals, in order to show that the irreligion of those men is not to be presumed an effect of deep and just thinking? Whether an attempt to detect false reasonings, and remedy defects in mathematics, ought to be ill received by mathematicians? Whether the introducing more easy methods and more intelligible principles in any science should be discountenanced? Whether there may not be fair objections as well as cavils? And whether to inquire diligently into the meaning of terms and the proof of propositions, not excepting against any thing without assigning a reason, nor affecting to mistake the signification of words, or stick at an expression where the sense was clear, but considering the subject in all lights, sincerely endeavouring to find out any sense or meaning whatsoever, candidly setting forth what seems obscure and what fallacious, and calling upon those who profess the knowledge of such matters to explain them; whether, I say, such a proceeding can be justly called cavilling? Whether there be an *ipse dixit* erected? And if so, when, where, by whom, and upon what authority? Whether even where authority was to take place, one might not hope the mathematics, at least, would be excepted? Whether the chief end, in making mathematics so considerable a part of academical education, be not to form in the minds of young students habits of just and exact reasoning? And whether the study of abstruse and subtile matters can conduce to this end, unless they are well understood, examined, and sifted to the bottom? Whether, therefore, the bringing geometrical demonstrations to the severest test of reason should be reckoned a discouragement to the studies of any learned society? Whether to separate the clear parts of things from the obscure, to distinguish the real principles whereon truths rest, and whence they are derived, and to proportion the just measures of assent according to the various degrees of evidence, be a useless or unworthy undertaking? Whether the making more of an argument than it will bear, and placing it in an undue rank of evidence, be not the likely way to disparage it? Whether it may not be of some use, to provoke and stir up the learned professors to explain a part of mathematical learning which is acknowledged to be most profound, difficult, and obscure, and at the same time set forth by Philalethes and many others, as the greatest instance that has ever been given of the extent of human abilities? Whether for the sake of a great man's discoveries, we must adopt his errors? Lastly, whether in an age wherein all other principles are canvassed with the utmost freedom, the principles of fluxions are to be alone excepted?

AN APPENDIX

CONCERNING MR. WALTON'S VINDICATION OF SIR ISAAC NEWTON'S PRINCIPLES OF FLUXIONS.

I. I HAD no sooner considered the performance of Philalethes, but Mr. Walton's Vindication of Fluxions was put into my hands. As this Dublin professor gleans after the Cantabrigian, only endeavouring to translate a few passages from Sir Isaac Newton's Principia, and enlarge on a hint or two of Philalethes, he deserves no particular notice. It may suffice to advertise the reader, that the foregoing defence contains a full and explicit answer to Mr. Walton, as he will find if he thinks it worth his pains to read what this gentleman hath written, and compare it therewith. Particularly with Sect. 18, 20, 30, 32—36, 43. It is not, I am sure, worth mine to repeat the same things, or confute the same notions twice over, in mere regard to a writer who hath copied even the manners of Philalethes, and whom in answering the other I have, if I am not much mistaken, sufficiently answered.

II. Mr. Walton touches on the same points that the other had touched upon before him. He pursues a hint which the other had given * about Sir Isaac's first section concerning the *rationes primæ et ultimæ*. He discreetly avoids, like the other, to say one syllable of second, third, or fourth fluxions, and of divers other points mentioned in the Analyst, about all which I observe in him a most prudent and profound silence. And yet he very modestly gives his reader to understand, that he is able to clear up all difficulties and objections, that have ever been made (p. 5). Mr. Walton in the beginning, like Philalethes, from a particular case makes a general inference, supposing that infidelity to be imputed to mathematicians in general, which I suppose only in the person to whom the Analyst was addressed, and certain other persons of the same mind with him. Whether this extraordinary way of reasoning be the cause or effect of his passion I know not: but before I had got to the end of his Vindication I ceased to be surprised at his logic and his temper in the beginning. The double error, which, in the Analyst, was plainly meant to belong to others, he with Philalethes (whose very oversights he adopts) supposeth to have been ascribed to Sir Isaac Newton (p. 36). And this writer also, as well as the Cantabrigian, must needs take upon him to explain the motive of my

* Philalethes, p. 32.

writing against fluxions: which he gives out, with great assurance, to have been because Sir Isaac Newton had presumed to interpose in prophecies and revelations, and to decide in religious affairs (p. 4); which is so far from being true, that, on the contrary, I have a high value for those learned remains of that great man, whose original and free genius is an eternal reproach to that tribe of followers, who are always imitating, but never resemble him. This specimen of Mr. Walton's truth will be a warning to the reader to use his own eyes, and in obscure points never to trust the gentleman's candour, who dares to misrepresent the plainest.

III. I was thinking to have said no more concerning this author's performance, but, lest he should imagine himself too much neglected, I entreat the reader to have the patience to peruse it; and if he finds any one point of the doctrine of fluxions cleared up, or any one objection in the Analyst answered, or so much as fairly stated, let him then make his compliments to the author. But if he can no more make sense of what this gentleman has written than I can, he will need no answer to it. Nothing is easier than for a man to translate, or copy, or compose a plausible discourse of some pages in technical terms, whereby he shall make a show of saying somewhat, although neither the reader nor himself understand one tittle of it. Whether this be the case of Mr. Walton, and whether he understands either Sir Isaac Newton, or me, or himself, whatever I may think, I shall not take upon me to say. But one thing I know, that many an unmeaning speech passeth for significant by the mere assurance of the speaker, till he cometh to be catechised upon it; and then the truth showeth itself. This vindicator, indeed, by his dissembling nine parts in ten of the difficulties proposed in the Analyst, showeth no inclination to be catechised by me. But his scholars have a right to be informed. I therefore recommend it to them not to be imposed on by hard words and magisterial assertions, but carefully to pry into his sense, and sift his meaning, and particularly to insist on a distinct answer to the following questions.

IV. Let them ask him whether he can conceive velocity without motion, or motion without extension, or extension without magnitude? If he answers that he can, let him teach them to do the same. If he cannot, let him be asked how he reconciles the idea of a fluxion which he gives (p. 13) with common sense? Again, let him be asked whether nothing be not the product of nothing multiplied by something? And if so, when the difference between the gnomon and the sum of the rectangles* vanisheth, whether the rectangles themselves do not also vanish?

* See Vindication, p. 17.

i. e. when ab is nothing, whether $Ab + Ba$ be not also nothing? i. e. whether the momentum of AB be not nothing? Let him then be asked what his momentums are good for, when they are thus brought to nothing? Again, I wish he were asked to explain the difference between a magnitude infinitely small and a magnitude infinitely diminished. If he saith there is no difference, then let him be further asked, how he dares to explain the method of fluxions by the ratio of magnitudes infinitely diminished (p. 9), when Sir Isaac Newton hath expressly excluded all consideration of quantities infinitely small?* If this able vindicator should say that quantities infinitely diminished are nothing at all, and consequently that, according to him, the first and last ratios are proportions between nothings, let him be desired to make sense of this or explain what he means by proportion between nothings. If he should say, the ultimate proportions are the ratios of mere limits, then let him be asked how the limits of lines can be proportioned or divided? After all, who knows but this gentleman, who hath already complained of me for an uncommon way of treating mathematics and mathematicians (p. 5), may (as well as the Cantabrigian) cry out, "Spain and the inquisition!" when he finds himself thus closely pursued and beset with interrogatories? That we may not, therefore, seem too hard on an innocent man, who probably meant nothing, but was betrayed by following another into difficulties and straits that he was not aware of, I shall propose one single expedient by which his disciples (whom it most concerns) may soon satisfy themselves whether this vindicator really understands what he takes upon him to vindicate. It is in short that they would ask him to explain the second, third, or fourth fluxions upon his principles. Be this the touchstone of his vindication. If he can do it, I shall own myself much mistaken: if he cannot, it will be evident that he was much mistaken in himself when he presumed to defend fluxions without so much as knowing what they are. So, having put the merits of the cause on this issue, I leave him to be tried by his scholars.

* See his Introduction to the Quadratures.

REASONS FOR NOT REPLYING

TO

MR. WALTON'S FULL ANSWER.

IN A LETTER TO P. T. P.

I. THERE are some men that can neither give nor take an answer, but, writing merely for the sake of writing, multiply words to no purpose. There are also certain careless writers, that in defiance of common sense publish such things as, though they are not ashamed to utter, yet other men may well be ashamed to answer. Whether there be any thing in Mr. Walton's method of vindicating fluxions, that might justify my taking no futher notice of him on the above-mentioned considerations, I leave you and every other reader to judge. But those, sir, are not the reasons I shall assign for not replying to Mr. Walton's full answer. The true reason is, that he seems at bottom a facetious man, who, under the colour of an opponent, writes on my side of the question, and really believes no more than I do of Sir Isaac Newton's doctrine about fluxions, which he exposes, contradicts, and confutes, with great skill and humour, under the mask of a grave vindication.

II. At first I considered him in another light, as one who had good reason for keeping to the beaten track, who had been used to dictate, who had terms of art at will, but was, indeed, at small trouble about putting them together, and perfectly easy about his reader's understanding them. It must be owned, in an age of so much ludicrous humour, it is not every one can, at first sight, discern a writer's real design. But, be a man's assertions ever so strong in favour of a doctrine, yet if his reasonings are directly levelled against it, whatever question there may be about the matter in dispute, there can be none about the intention of the writer. Should a person, so knowing and discreet as Mr. Walton, thwart and contradict Sir Isaac Newton under pretence of defending his fluxions, and should he at every turn say such uncouth things of these same fluxions, and place them in such odd lights, as must set all men in their wits against them, could I hope for a better second in this cause? Or could there remain any doubt of his being a disguised free-thinker in mathematics, who defended fluxions just as a certain free-thinker in religion did the rights of the Christian church.

III. Mr. Walton indeed, after his free manner, calls my Analyst a libel.* But this ingenious gentleman well knows, a bad vindication is the bitterest libel. Had you a mind, sir, to betray and ridicule any cause under the notion of vindicating it, would you not think it the right way to be very strong and dogmatical in the affirmative, and very weak and puzzled in the argumentative parts of your performance? To utter contradictions and paradoxes without remorse, and to be at no pains about reconciling or explaining them? And with great good humour, to be at perpetual variance with yourself and the author you pretend to vindicate? How successfully Mr. Walton hath practised these arts, and how much to the honour of the great client he would seem to take under his protection, I shall particularly examine throughout every article of his full answer.

IV. First, then, saith Mr. Walton, "I am to be asked, whether I can conceive velocity without motion, or motion without extension, or extension without magnitude?" To which he answereth in positive terms, that he can conceive velocity and motion in a point (p. 7). And to make out this, he undertakes to demonstrate, "that if a thing be moved by an agent, operating continually with the same force, the velocity will not be the same in any two different points of the described space. But that it must vary upon the least change of space." Now admitting thus much to be demonstrated, yet I am still at a loss to perceive how Mr. Walton's conclusion will follow, to wit, "that I am greatly mistaken in imagining there can be no motion, no velocity in a point of space," p. 10. Pray, sir, consider his reasoning. The same velocity cannot be in two points of space; therefore velocity can be in a point of space. Would it not be just as good reasoning to say, the same man cannot be in two nutshells; therefore a man can be in a nutshell? Again, velocity must vary upon the least change of space; therefore there may be velocity without space. Make sense of this if you can. What have these consequences to do with their premises? Who but Mr. Walton could have inferred them? Or how could even he have inferred them, had it not been in jest.

V. Suppose the centre of a falling body to describe a line, divide the time of its fall into equal parts, for instance into minutes. The spaces described in those equal parts of time will be unequal. That is, from whatsoever points of the described line you measure a minute's descent, you will still find it a different space. This is true. But how or why from this plain truth a man should infer, that motion can be conceived in a point, is to me as obscure as any the most obscure mysteries that occur in this profound author. Let the reader make the

* Vindication, p. 1.

best of it. For my part, I can as easily conceive Mr. Walton should walk without stirring, as I can his idea of motion without space. After all, the question was not whether motion could be proved to exist in a point, but only whether it could be conceived in a point. For, as to the proof of things impossible, some men have a way of proving that may equally prove any thing. But I much question, whether any reader of common sense will undertake to conceive what this pleasant man at inference undertakes to prove.

VI. If Mr. Walton really meant to defend the author of the fluxionary method, would he not have done it in a way consistent with this illustrious author's own principles? Let us now see what may be Sir Isaac's notion about this matter. He distinguisheth two sorts of motion, absolute and relative. The former he defineth to be a translation from absolute place to absolute place, the latter from one relative place to another.* Mr. Walton's is plainly neither of these sorts of motion, but some third kind, which, what it is, I am at a loss to comprehend. But I can clearly comprehend that, if we admit motion without space, then Sir Isaac Newton's account of it must be wrong: for place, by which he defines motion, is, according to him, a part of space. And if so, then this notable defender hath cut out new work for himself to defend and explain. But about this, if I mistake not, he will be very easy. For, as I said before, he seems at bottom a back friend to that great man; which opinion you will see further confirmed in the sequel.

VII. I shall no more ask Mr. Walton to explain any thing. For I can honestly say, the more he explains the more I am puzzled. But I will ask his readers to explain, by what art a man may conceive motion without space. And supposing this to be done, in the second place to explain, how it consists with Sir Isaac Newton's account of motion. Is it not evident, that Mr. Walton hath deserted from his old master, and been at some pains to expose him, while he defends one part of his principles by overturning another? Let any reader tell me what Mr. Walton means by motion, or if he can guess what this third kind is, which is neither absolute nor relative, which exists in a point, which may be conceived without space. This learned professor saith, "I have no clear conception of the principles of motion," p. 24. And in another place, p. 7, he saith, "I might have conceived velocity in a point, if I had understood and considered the nature of motion." I believe I am not alone in not understanding his principles. For myself, I freely confess the case to be desperate. I neither understand them, nor have any hopes of being ever able to understand them.

* See Schol. def. viii. Philos. Nat. Princip. Math.

VIII. Being now satisfied, that Mr Walton's aim is not to clear up or defend Sir Isaac's principles, but rather to contradict and expose them, you will not, I suppose, think it strange, if instead of putting questions to this intrepid answerer, who is never at a loss, how often soever his readers may, I entreat you, or any other man of plain sense, to read the following passage cited from the thirty-first section of the Analyst, and then try to apply Mr. Walton's answer to it: whereby you will clearly perceive what a vein of raillery that gentleman is master of. "Velocity necessarily implies both time and space, and cannot be conceived without them. And if the velocities of nascent and evanescent quantities, i. e. abstracted from time and space, may not be comprehended, how can we comprehend and demonstrate their proportions, or consider their *rationes primæ et ultimæ?* For to consider the proportion or ratio of things implieth that such things have magnitude: that such their magnitudes may be measured, and their relations to each other known. But as there is no measure of velocity except time and space, the proportion of velocities being only compounded of the direct proportion of the spaces and the reciprocal proportion of the times; doth it not follow, that to talk of investigating, obtaining, and considering the proportions of velocities, exclusively of time and space, is to talk unintelligibly?" Apply now, as I said, Mr. Walton's full answer, and you will soon find how fully you are enlightened about the nature of fluxions.

IX. In the following article of Mr. Walton's full answer, he saith divers curious things, which, being derived from this same principle, that motion may be conceived in a point, are altogether as incomprehensible as the origin from whence they flow. It is obvious and natural to suppose A $\dot{b}$ and B $\dot{a}$* to be rectangles produced from finite lines multiplied by increments. Mr. Walton indeed supposeth that when the increments vanish or become nothing, the velocities remain, which being multiplied by finite lines produce those rectangles (p. 13). But admitting the velocities to remain, yet how can any one conceive a rectangular surface to be produced from a line multiplied by velocity, otherwise than by supposing such line multiplied by a line or increment, which shall be exponent of or proportional to such velocity? You may try to conceive it otherwise. I must own I cannot. Is not the increment of a rectangle itself a rectangle? Must not then A $\dot{b}$ and B $\dot{a}$ be rectangles? And must not the coefficients or sides of rectangles be lines? Consequently are not $\dot{b}$ and $\dot{a}$ lines or (which is the same thing) increments of lines? These increments may indeed be considered as proportional to and exponents of velocity. But exclusive of such exponents, to talk of rectangles under lines and velocities is, I conceive, to talk unintelligibly. And yet this is what Mr.

* See Nat. Phil. Princip. Math. lib. ii. lem. 2.

Walton doth, when he maketh b and a, in the rectangles A b and B a, to denote mere velocities.

As to the question, whether nothing be not the product of nothing multiplied by something, Mr. Walton is pleased to answer in the affirmative. And nevertheless when $a\ b$ is nothing, that is, when a and b are nothing, he denies that A b + B a is nothing. This is one of those many inconsistencies which I leave the reader to reconcile. But, saith Mr. Walton, the sides of the given rectangle still remain, which two sides, according to him, must form the increment of the flowing rectangle. But in this he directly contradicts Sir Isaac Newton, who asserts that A b + B a, and not A + B, is the increment of the rectangle A B. And, indeed, how is it possible a line should be the increment of a surface? "Laterum incrementis totis a et b generatur rectanguli incrementum A b + B a," are the words of Sir Isaac,* which words seem utterly inconsistent with Mr. Walton's doctrine. But no wonder that gentleman should not agree with Sir Isaac, since he cannot agree even with himself; but contradicts what he saith elsewhere, as the reader may see, even before he gets to the end of that same section, wherein he hath told us that "the gnomon and the sum of the two rectangles are turned into those two sides by a retroverted motion" (p. 11, 12). Which proposition if you or any other person shall try to make sense of, you may possibly be convinced, that this profound author is as much at variance with common sense, as he is with himself and Sir Isaac Newton.

XI. Mr. Walton, in the ninth page of his Vindication, in order to explain the nature of fluxions, saith that "to obtain the last ratio of synchronal increments, the magnitude of those increments must be infinitely diminished." Notwithstanding which, in the twenty-third page of his full answer, he chargeth me as greatly mistaken, in supposing that he explained the doctrine of fluxions by the ratio of magnitudes infinitely diminished. It is an easy matter for any author to write so as to betray his readers into mistakes about his meaning. But then it is not easy to conceive, what right he hath to upbraid them with such their mistakes. If I have mistaken his sense, let any one judge if he did not fairly lead me into the mistake. When a man puzzleth his reader, saith and unsaith, useth ambiguous terms and obscure terms, and putteth them together in so perverse a manner, that it is odds you can make out no sense at all, or if any, a wrong sense, pray who is in fault but the writer himself? Let any one consider Mr. Walton's own words, and then say whether I am not justified in making this remark.

XII. In the twentieth page of his full answer Mr. Walton tells us, that "fluxions are measured by the first or last proportions of isochronal increments generated or destroyed by motion." A little after he saith these ratios subsist when the isochronal

* Nat. Phil. Princip. Math. lib. ii. lem. 2.

increments have no magnitude. Now, I would fain know whether the isochronal increments themselves subsist when they have no magnitude? Whether by isochronal increments we are not to understand increments generated in equal times? Whether there can be an increment where there is no increase, or increase where there is no magnitude? Whether if magnitudes are not generated in those equal times, what else is generated therein, or what else is it that Mr. Walton calls isochronal? I ask the reader these questions. I dare not ask Mr. Walton. For, as I hinted before, the subject grows still more obscure in proportion as this able writer attempts to illustrate it.

XIII. We are told, p. 22, "that the first or last ratio of the isochronal spaces hath a real existence, forasmuch as it is equal to the ratio of the two motions of two points; which motions, subsisting when the isochronal spaces are nothing, preserve the existence of the first or last ratio of these spaces, or keep it from being a ratio of nothings." In order to assist your understanding, it must not be omitted that the said two points are supposed to exist at the same time in one point, and to be moved different ways without stirring from that point. Mr. Walton hath the conscience to call this riddle a full and clear answer: to make sense of which you must suppose it one of his ironies. In the next and last article of his performance, you still find him proceed in the same vein of raillery upon fluxions.

XIV. It will be allowed, that whoever seriously undertook to explain the second, third, and fourth fluxions of Sir Isaac Newton, would have done it in a way agreeable to that great man's own doctrine. What Sir Isaac's precise notion is I will not pretend to say. And yet I will venture to say, it is something that cannot be explained by the three dimensions of a cube. I frankly own, I do not understand Sir Isaac's doctrine so far as to frame a positive idea of his fluxions. I have, nevertheless, a negative conception thereof, so far as to see that Mr. Walton is in jest, or (if in earnest) that he understands it no more than I do.

XV. Sir Isaac tells us that he considers indeterminate quantities as flowing, or, in other words, as increasing or decreasing by a perpetual motion. Which quantities he denotes by the latter letters of the alphabet, and their fluxions or celerities of increasing by the same letters pointed over head, and the fluxions of fluxions, or second fluxions, i. e. the mutations more or less swift of the first celerities, by the same letters pointed with double points; and the mutations of those mutations of the first mutations, or fluxions or celerities of increasing, which he calls fluxions of fluxions of fluxions, or third fluxions, by three points; the fourth fluxions by four points; the fifth by five; and so on.* Sir Isaac, you see, speaks of quantity in general. And in the

* See his treatise De Quadraturâ Curvarum.

Analyst the doctrine is exemplified and the case is put in lines. Now in lines, where there is only one dimension, how are we enabled to conceive second, third, or fourth fluxions, by conceiving the generation of three dimensions in a cube? Let any one but read what Sir Isaac Newton or what I have said, and then apply what Mr. Walton hath written about the three dimensions of a cube, and see whether the difficulties are solved, or the doctrine made one whit the clearer by this explication.

XVI. That you may the better judge of the merit of this part of Mr. Walton's performance, I shall beg leave to set down a passage or two from the Analyst. "As it is impossible to conceive velocity without time or space, without either finite length or finite duration, it must seem above the power of man to comprehend even the first fluxions. And if the first are incomprehensible, what shall we say of the second and third fluxions, &c.? He who can conceive the beginning of a beginning or the end of an end, somewhat before the first or after the last, may perhaps be sharp-sighted enough to conceive these things. But most men, I believe, will find it impossible to understand them in any sense whatsoever. One would think that men could not speak too exactly on so nice a subject. And yet we may often observe, that the exponents of fluxions, or notes representing fluxions, are confounded with the fluxions themselves. Is not this the case, when just after the fluxions of flowing quantities were said to be the celerities of their increasing, and the second fluxions to be the mutations of the first fluxions or celerities, we are told that $\ddot{z}.\ \dot{z}.\ z.\ \dot{z}.\ \ddot{z}.\ \dddot{z}.$ represents a series of quantities whereof each subsequent quantity is the fluxion of the preceding; and each foregoing is a fluent quantity having the following one for its fluxion. Divers series of quantities and expressions geometrical and algebraical may be easily conceived in lines, in surfaces, in species, to be continued without end or limit. But it will not be found so easy to conceive a series, either of mere velocities or of mere nascent increments, distinct therefrom and corresponding thereunto."* Compare what is here said with Mr. Walton's genesis of a cube, and you will then clearly see how far this answerer is from explaining the nature of second, third, and fourth fluxions: and how justly I might repay that gentleman in kind, and tell him in his own language, that "all his skill is vain and impertinent," Vind. p. 36.

XVII. But it doth not become me to find fault with this learned professor, who at bottom militates on my side, and in this very section makes it his business directly to overthrow Sir Isaac Newton's doctrine. For he saith in plain terms, that there can be no fourth fluxion of a cube (p. 25), that is, there can be no second fluxion of a line, and, *à fortiori*, no third, fourth, fifth,

* Analyst, sect. xliv., xlv., xlvi.

&c. Insomuch, that with one single dash of his pen, Mr. Walton destroys, to the great relief of the learned world, an indefinite rank of fluxions of different orders that might have reached from pole to pole. I had distinctly pointed out the difficulties in several parts both of my Analyst and Defence, and I leave you to judge whether he explains or even attempts to explain one of them. Instead thereof he tells us of the trine dimension of a cube generated by motion: whence he takes occasion, as hath been observed, to explode Sir Isaac's own doctrine, which is utterly inconsistent with Mr. Walton's. And can you now doubt the real design of this egregious vindicator?

XVIII. Before ever Sir Isaac Newton thought of his fluxions, everybody knew there were three dimensions in a cube, and that a solid might be generated by the motion of a surface, a surface by the motion of a line, and a line by the motion of a point. And this in effect is all we know from Mr. Walton's explication. As for his dwelling so minutely on the genesis of the solid parts of a cube, a thing so foreign from the purpose, the only rational account I can give of it is, that Mr. Walton, by puzzling the imagination of his vulgar readers, hoped the better to disguise his betraying the doctrine of his great client, which to a discerning eye he manifestly gives up; and instead thereof humorously substitutes, what all the world knew before Sir Isaac was born, to wit, the three dimensions of a cube and the genesis thereof by motion.

XIX. Upon the whole, I appeal to you and every intelligent reader, whether this thing, which Mr. Walton is pleased ironically to call a full answer, doth not carry throughout a sly insinuation, that the profound science of fluxions cannot be maintained but by the help of most unintelligible paradoxes and inconsistencies. So far, indeed, as affirmations go he showeth himself an able support of Sir Isaac Newton. But then in his reasonings he drops that great man upon the most important points, to wit, his doctrine of motion and his doctrine of fluxions, not regarding how far the demonstration of his famous Principia is interested therein. To convince you still more and more of the truth hereof, do but reflect a little on Mr. Walton's conduct. Can you think it probable, that so learned and clear-headed a writer would have laid down such a direct repugnancy to common sense, as his idea of motion in a point, for the ground-work of his explanation, had it been his real intention to explain? Or can you suppose he would have been absolutely silent on so many points urged home, both in the Analyst and Defence, which it concerned a vindicator of Sir Isaac not to have overlooked? Can you imagine, that if he meant seriously to defend the doctrine of fluxions, he would have contented himself with barely asserting that "Sir Isaac Newton, in the introduction to his Quadrature of Curves, in the second lemma of the second

book, and in the scholium to the first section of the first book of his principles of philosophy, hath delivered his doctrine of fluxions in so clear and distinct a manner, without the least inconsistency in terms and arguments, that one would have thought it impossible for any person not to have understood him," p. 30.

XX. Is it possible, I say, that Mr. Walton could in earnest hope we should take his bare word, as so much more credible than Sir Isaac's, and not rather have endeavoured to answer the questions and reconcile the difficulties set forth in my Defence of Free-thinking, for instance, in sect. xxxvi. Wherein I entreat my antagonist to explain "whether Sir Isaac's momentum be a finite quantity, or an infinitesimal, or a mere limit;" adding, "If you say a finite quantity, be pleased to reconcile this with what he saith in the scholium of the second lemma of the first section of the first book of his Principles: 'Cave intelligas quantitates magnitudine determinatas, sed cogita semper diminuendas sine limite.' If you say an infinitesimal, reconcile this with what is said in his introduction to the Quadratures: 'Volui ostendere quod in methodo fluxionum non opus sit figuras infinite parvas in geometriam inducere.' If you should say it is a mere limit, be pleased to reconcile this with what we find in the first case of the second lemma in the second book of his Principles: 'Ubi de lateribus A et B deerant momentorum dimidia,' &c., where the moments are supposed to be divided." I shall scarce think it worth my while to bestow a serious thought on any writer who shall pretend to maintain Sir Isaac's doctrine, and yet leave this passage without a reply. And the reader, I believe, will think with me that, in answer to difficulties distinctly proposed and insisted on, to offer nothing but a magisterial assertion is a mere grimace of one who made merry with fluxions, under the notion of defending them. And he will be further confirmed in this way of thinking, when he observes that Mr. Walton hath not said one syllable in reply to those several sections of my defence, which I had particularly referred to, as containing a full answer to his Vindication. But it is no wonder if, with Sir Isaac's doctrine, he should drop also his own arguments in favour thereof.

XXI. I have been at the pains once for all to write this short comment on Mr. Walton, as the only way I could think of for making him intelligible, which will also serve as a key to his future writings on this subject. And I was the rather inclined to take this trouble, because it seemeth to me, there is no part of learning that wants to be cleared up more than this same doctrine of fluxions, which hath hitherto walked about in a mist to the stupefaction of the literati of the present age. To conclude, I accept this professor's recantation, nor am at all displeased at the ingenious method he takes to disguise it. Some zealous fluxionist may perhaps answer him.

AN ESSAY

TOWARDS

PREVENTING THE RUIN OF GREAT BRITAIN.

AN ESSAY,

ETC.

WHETHER the prosperity that preceded, or the calamities that succeed the South Sea project have most contributed to our undoing, is not so clear a point as it is that we are actually undone, and lost to all sense of our true interest; nothing less than this could render it pardonable to have recourse to those old-fashioned, trite maxims concerning religion, industry, frugality, and public spirit, which are now forgotten, but if revived and put in practice, may not only prevent our final ruin, but also render us a more happy and flourishing people than ever.

Religion hath in former days been cherished and reverenced by wise patriots and lawgivers, as knowing it to be impossible that a nation should thrive and flourish without virtue, or that virtue should subsist without conscience, or conscience without religion: insomuch that an atheist or infidel was looked on with abhorrence, and treated as an enemy to his country. But in these wiser times, a cold indifference for the national religion, and indeed for all matters of faith and divine worship, is thought good sense. It has even become fashionable to decry religion; and that little talent of ridicule is applied to such wrong purposes, that a good Christian can hardly keep himself in countenance.

Liberty is the greatest human blessing that a virtuous man can possess, and is very consistent with the duties of a good subject and a good Christian; but the present age aboundeth with injudicious patrons of liberty, who, not distinguishing between that and licentiousness, take the surest method to discredit what they would seem to propagate; for, in effect, can there be a greater affront offered to that just freedom of thought and action, which is the prerogative of a rational creature, or can any thing recommend it less to honest minds, than under colour thereof to obtrude scurrility and profaneness on the world? But it hath been always observed of weak men, that they know not how to avoid one extreme without running into another.

Too many of this sort pass upon vulgar readers for great authors and men of profound thought, not on account of any superiority either in sense or style, both which they possess in a very moderate degree, nor of any discoveries they have made in arts or sciences, which they seem to be little acquainted with: but purely because they flatter the passions of corrupt men, who

are pleased to have the clamours of conscience silenced, and those great points of the Christian religion made suspected, which withheld them from many vices of pleasure and interest, or made them uneasy in the commission of them.

In order to promote that laudable design of effacing all sense of religion from among us, they form themselves into assemblies, and proceed with united counsels and endeavours; with what success, and with what merit towards the public, the effect too plainly shows; I will not say, these gentlemen have formed a direct design to ruin their country, or that they have the sense to see half the ill consequences which must necessarily flow from the spreading of their opinions; but the nation feels them, and it is high time the legislature put a stop to them.

I am not for placing an invidious power in the hands of the clergy, or complying with the narrowness of any mistaken zealots, who should incline to persecute dissenters: but whatever conduct common sense, as well as Christian charity, obligeth us to use, towards those who differ from us in some points of religion, yet the public safety requireth, that the avowed contemners of all religion should be severely chastised, and perhaps it may be no easy matter to assign a good reason why blasphemy against God should not be inquired into, and punished with the same rigour as treason against the king.

For though we may attempt to patch up our affairs, yet it will be to no purpose; the finger of God will unravel all our vain projects, and make them snares to draw us into greater calamities, if we do not reform that scandalous libertinism which (whatever some shallow men may think) is our worst symptom and the surest prognostic of our ruin.

Industry is the natural sure way to wealth; this is so true, that it is impossible an industrious free people should want the necessaries and comforts of life, or an idle enjoy them under any form of government. Money is so far useful to the public, as it promoteth industry, and credit, having the same effect, is of the same value with money; but money or credit circulating through a nation from hand to hand, without producing labour and industry in the inhabitants, is direct gaming.

It is not impossible for cunning men to make such plausible schemes, as may draw those who are less skilful into their own and the public ruin. But surely, there is no man of sense and honesty, but must see and own, whether he understands the game or not, that it is an evident folly for any people, instead of prosecuting the old honest methods of industry and frugality, to sit down to a public gaming-table, and play off their money one to another.

The more methods there are in a state for acquiring riches without industry or merit, the less there will be of either in that state; this is as evident as the ruin that attends it. Besides,

when money is shifted from hand to hand in such a blind, fortuitous manner, that some men shall from nothing in an instant acquire vast estates, without the least desert; while others are as suddenly stripped of plentiful fortunes, and left on the parish by their own avarice and credulity, what can be hoped for on the one hand, but abandoned luxury and wantonness, or on the other, but extreme madness and despair.

In short, all projects for growing rich by sudden and extraordinary methods, as they operate violently on the passions of men, and encourage them to despise the slow, moderate gains that are to be made by an honest industry, must be ruinous to the public, and even the winners themselves will at length be involved in the public ruin.

It is an easy matter to contrive projects for the encouragement of industry; I wish it were as easy to persuade men to put them in practice. There is no country in Europe where there is so much charity collected for the poor, and none where it is so ill managed. If the poor-tax was fixed at a medium in every parish, taken from a calculation of the last ten years, and raised for seven years by act of parliament, that sum (if the common estimate be not very wrong) frugally and prudently laid out in workhouses, would for ever free the nation from the care of providing for the poor, and at the same time considerably improve our manufactures. We might by these means rid our streets of beggars; even the children, the maimed, and the blind might be put in a way of doing something for their livelihood. As for the small number of those who by age or infirmities are utterly incapable of all employment, they might be maintained by the labour of others; and the public would receive no small advantage from the industry of those who are now so great a burthen and expense to it.

The same tax, continued three years longer, might be very usefully employed in making high roads, and rendering rivers navigable, two things of so much profit and ornament to a nation, that we seem the only people in Europe who have neglected them.* So that in the space of ten years the public may be for ever freed from a heavy tax, industry encouraged, commerce facilitated, and the whole country improved, and all this only by a frugal, honest management, without raising one penny extraordinary.

The number of people is both means and motives to industry; it should therefore be of great use to encourage propagation, by allowing some reward or privilege to those who have a certain number of children; and on the other hand, enacting that the public shall inherit half the unentailed estates of all who die unmarried of either sex.

* This was published before turnpikes were erected.

Besides the immediate end proposed by the foregoing methods, they furnish taxes upon passengers, and dead bachelors, which are in no sort grievous to the subject, and may be applied towards clearing the public debt, which, all mankind agree, highly concerneth the nation in general, both court and country. Cæsar, indeed, mentions it as a piece of policy, that he borrowed money from his officers to bestow it on the soldiers, which fixed both to his interest; and though something like this may pass for skill at certain junctures in civil government, yet if carried too far, it will prove a dangerous experiment.

There is still room for invention or improvement in most trades and manufactures, and it is probable that premiums given on that account to ingenious artists, would soon be repaid a hundredfold to the public. No colour is so much worn in Italy, Spain, and Portugal as black; but our black cloth is neither so lasting nor of so good a dye as the Dutch, which is the reason of their engrossing the profit of that trade: this is so true, that I have known English merchants abroad wear black cloth of Holland themselves, and sell and recommend it as better than that of their own country. It is commonly said the water of Leyden hath a peculiar property for colouring black; but it hath also been said and passed current, that good glasses may be made no where but at Venice, and there only in the little island of Murano: which was attributed to some peculiar property in the air; and we may possibly find other opinions of that sort to be as groundless, should the legislature think it worth while to propose premiums in the foregoing, or in the like cases of general benefit to the public; but I remember to have seen, about seven years ago, a man pointed at in a coffee-house, who (they said) had first introduced the right scarlet dye among us, by which the nation in general, as well as many private persons, have since been great gainers, though he was himself a beggar, who, if this be true, deserved an honourable maintenance from the public.

There are also several manufactures which we have from abroad, that may be carried on to as great perfection here as elsewhere. If it be considered that more fine linen is worn in Great Britain than in any other country of Europe, it will be difficult to assign a reason why paper may not be made here as good, and in the same quantity, as in Holland, or France, or Genoa. This is a manufacture of great consumption, and would save much to the public. The like may be said of tapestry, lace, and other manufactures, which, if set on foot in cheap parts of the country, would employ many hands, and save money to the nation, as well as bring it from abroad. Projects for improving old manufactures, or setting up new ones, should not be despised in a trading country, but the making them pretences for stock-jobbing hath been a fatal imposition.

As industry dependeth upon trade, and this, as well as the public security, upon our navigation, it concerneth the legislature to provide that the number of our sailors do not decrease, to which it would very much conduce, if a law were made prohibiting the payment of sailors in foreign parts; for it is usual with those on board merchantmen, as soon as they set foot on shore, to receive their pay, which is soon spent in riotous living; and when they have emptied their pockets, the temptation of a pistole present money, never faileth to draw them into any foreign service. To this (if I may credit the information I have had from some English factors abroad) it is chiefly owing, that the Venetians, Spaniards, and others, have so many English on board their ships; some merchants indeed and masters of vessels may make a profit in defrauding those poor wretches, when they pay them in strange coin (which I have been assured often amounts to twelvepence in the crown), as well as in ridding themselves of the charge of keeping them when they sell their ships, or stay long in port, but the public lose both the money and the men: who if their arrears were to be cleared at home, would be sure to return, and spend them in their own country; it is a shame this abuse should not be remedied.

Frugality of manners is the nourishment and strength of bodies politic. It is that by which they grow and subsist, until they are corrupted by luxury, the natural cause of their decay and ruin. Of this we have examples in the Persians, Lacedæmonians, and Romans: not to mention many later governments which have sprung up, continued a while, and then perished by the same natural causes. But these are, it seems, of no use to us; and, in spite of them, we are in a fair way of becoming ourselves another useless example to future ages.

Men are apt to measure national prosperity by riches; it would be righter to measure it by the use that is made of them. Where they promote an honest commerce among men, and are motives to industry and virtue, they are without doubt of great advantage; but where they are made (as too often happens) an instrument to luxury, they enervate and dispirit the bravest people. So just is that remark of Machiavel, that there is no truth in the common saying, money is the nerves of war; and though we may subsist tolerably for a time among corrupt neighbours, yet if ever we have to do with a hardy, temperate, religious sort of men, we shall find to our cost, that all our riches are but a poor exchange for that simplicity of manners which we despise in our ancestors.

This sole advantage hath been the main support of all the republics that have made a figure in the world; and perhaps it might be no ill policy in a kingdom to form itself upon the manners of a republic.

Simplicity of manners may be more easily preserved in a re-

public than a monarchy; but if once lost, may be sooner recovered in a monarchy, the example of a court being of great efficacy, either to reform or to corrupt a people; that alone were sufficient to discountenance the wearing of gold or silver, either in clothes or equipage; and if the same were prohibited by law, the saving so much bullion would be the smallest benefit of such an institution; there being nothing more apt to debase the virtue and good sense of our gentry of both sexes, than the trifling vanity of apparel, which we have learnt from France, and which hath had such visible ill consequences on the genius of that people. Wiser nations have made it their care to shut out this folly by severe laws and penalties, and its spreading among us can forebode no good, if there be any truth in the observation of one of the ancients, that the direct way to ruin a man is to dress him up in fine clothes.

It cannot be denied that luxury of dress giveth a light behaviour to our women, which may pass for a small offence, because it is a common one, but is in truth the source of great corruptions. For this very offence the prophet Isaiah denounced a severe judgment against the ladies of his time. I shall give the passage at length: "Moreover, the Lord saith, Because the daughters of Zion are haughty, and walk with stretched forth necks and wanton eyes, walking and mincing as they go, and making a tinkling with their feet; therefore the Lord will smite with a scab the crown of the head of the daughters of Zion, and the Lord will discover their secret parts. In that day the Lord will take away the bravery of their tinkling ornaments about their feet, and their cauls and their round tires like the moon, the chains, and the bracelets, and the mufflers, the bonnets, and the ornaments of the legs, and the headbands, and the tablets, and the earrings, the rings and nose-jewels, the changeable suits of apparel, and the mantles, and the wimples, and the crisping pins, the glasses, and the fine linen, and the hoods, and the veils. And it shall come to pass, that instead of a sweet smell there shall be a stink; and instead of a girdle a rent; and instead of well set hair, baldness; and instead of a stomacher, a girding of sackcloth; and burning instead of beauty." The scab, the stench, and the burning, are terrible pestilential symptoms, and our ladies would do well to consider, they may chance to resemble those of Zion in their punishment as well as their offence.

But dress is not the only thing to be reformed; sumptuary laws are useful in many other points. In former times the natural plainness and good sense of the English made them less necessary. But ever since the luxurious reign of King Charles the Second, we have been doing violence to our natures, and are by this time so much altered for the worse, that it is to be feared the very same dispositions that make them necessary, will for ever hinder them from being enacted or put in execution.

A private family in difficult circumstances, all men agree, ought to melt down their plate, walk on foot, retrench the number of their servants, wear neither jewels nor rich clothes, and deny themselves expensive diversions; and why not the public? Had any thing like this been done, our taxes had been less, or, which is the same thing, we should have felt them less. But it is very remarkable that luxury was never at so great a height, nor spread so generally through the nation as during the expense of the late wars, and the heavy debt that still lieth upon us.

This vice draweth after it a train of evils which crüelly infest the public; faction, ambition, envy, avarice, and that of the worst kind, being much more hurtful in its consequences, though not so infamous as penury. It was the great art of cardinal Richelieu, by encouraging luxury and expense to impoverish the French nobility, and render them altogether dependent on the crown, which hath been since very successfully effected. These and many more considerations show the necessity there is for sumptuary laws, nor can any thing be said against them in this island which might not with equal force be objected in other countries, which have nevertheless judged the public benefit of such institutions to be of far greater importance than the short sufferings of a few who subsist by the luxury of others.

It is evident that old taxes may be better borne, as well as new ones raised, by sumptuary laws judiciously framed, not to damage our trade, but retrench our luxury. It is evident, that, for want of these, luxury (which, like the other fashions, never faileth to descend) hath infected all ranks of people, and that this enableth the Dutch and French to undersell us, to the great prejudice of our traffic. We cannot but know, that in our present circumstances it should be our care, as it is our interest, to make poverty tolerable; in short, we have the experience of many ages to convince us, that a corrupt, luxurious people must of themselves fall into slavery, although no attempt be made upon them. These and the like obvious reflections should, one would think, have forced any people in their senses upon frugal measures.

But we are doomed to be undone. Neither the plain reason of the thing, nor the experience of past ages, nor the examples we have before our eyes, can restrain us from imitating, not to say surpassing, the most corrupt and ruined people, in those very points of luxury that ruined them. Our gaming, our operas, our masquerades, are, in spite of our debts and poverty, become the wonder of our neighbours. If there be any man so void of all thought and common sense as not to see where this must end, let him but compare what Venice was at the league of Cambray with what it is at present, and he will be convinced how truly those fashionable pastimes are calculated to depress and ruin a nation.

But neither Venice nor Paris, nor any other town in any part of the world, ever knew such an expensive, ruinous folly as our masquerade. This alone is sufficient to inflame and satisfy the several appetites for gaming, dressing, intriguing, luxurious eating and drinking. It is a most skilful abridgment, the very quintessence, the abstract of all those senseless vanities that have ever been the ruin of fools and detestation of wise men. And all this, under the notion of an elegant entertainment, hath been admitted among us; though it be in truth a contagion of the worst kind. The plague, dreadful as it is, is an evil of short duration; cities have often recovered and flourished after it; but when was it known that a people broken and corrupt by luxury recovered themselves? Not to say that general corruption of manners never faileth to draw after it some heavy judgment of war, famine, or pestilence. Of this we have a fresh instance in one of the most debauched towns of Europe,* and nobody knows how soon it may be our own case. This elegant entertainment is indeed suspended for the present, but there remains so strong a propension towards it, that, if the wisdom of the legislature does not interpose, it will soon return with the additional temptation of having been forbid for a time. It were stupid and barbarous to declaim against keeping up the spirit of the people by proper diversions; but then they should be proper, such as polish and improve their minds, or increase the strength and activity of their bodies; none of which ends are answered by the masquerade, no more than by those French and Italian follies, which, to our shame, are imported and encouraged at a time when the nation ought to be too grave for such trifles.

It is not to be believed what influence public diversions have on the spirit and manners of a people. The Greeks wisely saw this, and made a very serious affair of their public sports. For the same reason it will perhaps seem worthy the care of our legislature to regulate the public diversions by an absolute prohibition of those which have a direct tendency to corrupt our morals, as well as by a reformation of the drama; which, when rightly managed, is such a noble entertainment, and gave those fine lessons of morality and good sense to the Athenians of old, and to our British gentry above a century ago; but for these last ninety years hath entertained us, for the most part, with such wretched things as spoil, instead of improving, the taste and manners of the audience. Those who are attentive to such propositions only as may fill their pockets, will probably slight these things as trifles below the care of the legislature. But I am sure all honest thinking men must lament to see their country run headlong into all those luxurious follies, which, it is evident,

* Marseilles.

have been fatal to other nations, and will undoubtedly prove fatal to us also, if a timely stop be not put to them.

Public spirit, that glorious principle of all that is great and good, is so far from being cherished or encouraged, that it is become ridiculous in this enlightened age, which is taught to laugh at every thing that is serious as well as sacred. The same atheistical narrow spirit, centring all our cares upon private interest, and contracting all our hopes within the enjoyment of this present life, equally produceth a neglect of what we owe to God and our country. Tully hath long since observed, "that it is impossible for those who have no belief of the immortality of the soul, or a future state of rewards and punishments, to sacrifice their particular interests and passions to the public good, or have a generous concern for posterity," and our own experience confirmeth the truth of this observation.

In order therefore to recover a sense of public spirit, it is to be wished that men were first affected with a true sense of religion; *pro aris et focis*, having ever been the great motive to courage and perseverance in a public cause.

It would likewise be a very useful policy, and warranted by the example of the wisest governments, to make the natural love of fame and reputation subservient to promoting that noble principle. Triumphal arches, columns, statues, inscriptions, and the like monuments of public services, have, in former times, been found great incentives to virtue and magnanimity, and would probably have the same effects on Englishmen which they have had on Greeks and Romans. And perhaps, a pillar of infamy would be found a proper and exemplary punishment in cases of signal public villany, where the loss of fortune, liberty, or life, are not proportioned to the crime; or where the skill of the offender, or the nature of his offence, may screen him from the letter of the law.

Several of these are to be seen at Genoa, Milan, and other towns of Italy, where it is the custom to demolish the house of a citizen, who hath conspired the ruin of his country, or been guilty of any enormous crime towards the public, and in place thereof to erect a monument of the crime, and criminal, described in the blackest manner. We have nothing of this sort, that I know, but that which is commonly called the monument, which, in the last age, was erected for an affair no way more atrocious than the modern unexampled attempt * of men, easy in their fortunes, and unprovoked by hardships of any sort, in cool blood, and with open eyes, to ruin their native country. This fact will never be forgotten, and it were to be wished, that with it the public detestation thereof may be transmitted to pos-

* The South-sea project.

terity, which would, in some measure, vindicate the honour of the present, and be a useful lesson to future ages.

Those noble arts of architecture, sculpture, and painting, do not only adorn the public, but have also an influence on the minds and manners of men, filling them with great ideas, and spiriting them up to an emulation of worthy actions. For this cause they were cultivated and encouraged by the Greek cities, who vied with each other in building and adorning their temples, theatres, porticos, and the like public works, at the same time that they discouraged private luxury, the very reverse of our conduct.

To propose the building a parliament house, courts of justice, royal palace, and other public edifices, suitable to the dignity of the nation, and adorning them with paintings and statues, which may transmit memorable things and persons to posterity, would probably be laughed at as a vain affair, of great expence, and little use to the public; and it must be owned, we have reduced ourselves to such straits, that any proposition of expense suiteth ill with our present circumstances. But how proper soever this proposal may be for the times, yet it comes so properly into a discourse of public spirit, that I could not but say something of it. And at another time it will not seem unreasonable, if we consider that it is no more than the wisest nations have done before us, that it would spirit up new arts, employ many hands, keep the money circulating at home, and, lastly, that it would be a notable instance of public spirit, as well as a motive to it.

The same noble principle may be also encouraged by erecting an academy of ingenious men, whose employment it would be to compile the history of Great Britain, to make discourses proper to inspire men with a zeal for the public, and celebrate the memory of those who have been ornaments to the nation, or done it eminent service. Not to mention that this would improve our language, and amuse some busy spirits of the age; which, perhaps, would be no ill policy.

This is not without example; for, to say nothing of the French academy, which is prostituted to meaner purposes, it hath been the custom of the Venetian senate, to appoint one of their order to continue the history of the republic. This was introduced in the flourishing state of that people, and is still in force. We fall short of other nations in the number of good historians, though no nation in christendom hath produced greater events, or more worthy to be recorded. The Athenian senate appointed orators to commemorate annually, those who died in defence of their country, which solemnity was performed at the monuments erected in honour of them by the public; and the panegyrics, composed by Isocrates and Pericles, as well as many passages in Tully, inform us, with what pleasure the ancient orators used to expatiate in praise of their country.

Concord and union among ourselves is rather to be hoped for, as an effect of public spirit, than proposed as a means to promote it. Candid, generous men, who are true lovers of their country, can never be enemies to one half of their countrymen, or carry their resentments so far as to ruin the public for the sake of a party. Now I have fallen upon the mention of our parties, I shall beg leave to insert a remark or two, for the service both of whig and tory, without entering into their respective merits. First, it is impossible for either party to ruin the other, without involving themselves and their posterity in the same ruin. Secondly, it is very feasible for either party to get the better of the other, if they could first get the better of themselves; and instead of indulging the little womanish passions of obstinacy, resentment, and revenge, steadily promote the true interest of their country, in those great clear points of piety, industry, sobriety of manners, and an honest regard for posterity; which, all men of sense agree, are essential to public happiness. There would be something so great and good in this conduct, as must necessarily overbear all calumny and opposition. But that men should act reasonably, is rather to be wished than hoped.

I am well aware, that to talk of public spirit, and the means of retrieving it, must, to narrow sordid minds, be matter of jest and ridicule, how conformable soever it be to right reason, and the maxims of antiquity. Though one would think, the most selfish men might see it was their interest to encourage a spirit in others, by which they, to be sure, must be gainers. Yet such is the corruption and folly of the present age, that a public spirit is treated like ignorance of the world, and want of sense; and all the respect is paid to cunning men, who bend and wrest the public interest to their own private ends, that in other times hath been thought due to those who were generous enough to sacrifice their private interest to that of their country.

Such practices and such maxims as these must necessarily ruin a state. But if the contrary should prevail, we may hope to see men in power prefer the public wealth and security to their own, and men of money make free gifts, or lend it without interest to their country. This, how strange and incredible soever it may seem to us, hath been often done in other states. And the natural English temper considered, together with the force of example, no one can tell how far a proposal for a free gift may go among the monied men, when set on foot by the legislature, and encouraged by the example of two or three men of figure, who have the spirit to do a generous thing, and the understanding to see it is every private man's interest to support that of the public.

If they who have their fortunes in money should make a voluntary gift, the public would be eased, and at the same time

maintain its credit. Nor is a generous love of their country the only motive that should induce them to this. Common equity requires, that all subjects should equally share the public burthen. And common sense shows, that those who are foremost in the danger, should not be the most backward in contributing to prevent it.

Before I leave this subject, I cannot but take notice of that most infamous practice of bribery, than which nothing can be more opposite to public spirit, since every one who takes a bribe plainly owns, that he prefers his private interest to that of his country. This corruption is become a national crime, having infected the lowest as well as the highest among us, and is so general and notorious, that, as it cannot be matched in former ages, so it is to be hoped it will not be imitated by posterity.

This calls to mind another national guilt, which we possess in a very eminent degree; there being no nation under the sun, where solemn perjury is so common, or where there are such temptations to it. The making men swear so often in their own cases, and where they have an interest to conceal the truth, hath gradually wore off that awful respect which was once thought due to an appeal to Almighty God; insomuch, that men now-a-days break their fast and a custom-house oath with the same peace of mind. It is a policy peculiar to us, the obliging men to perjure or betray themselves, and hath had no good effect, but many very ill ones. Sure I am, that other nations, without the hundredth part of our swearing, contrive to do their business at least as well as we do. And perhaps our legislature will think it proper to follow their example. For whatever measures are taken, so long as we lie under such a load of guilt, as national perjury and national bribery, it is impossible we can prosper.

This poor nation hath sorely smarted of late, and to ease the present smart, a sudden remedy (as is usual in such cases) hath been thought of. But we must beware not to mistake an anodyne for a cure. Where the vitals are touched, and the whole mass of humours vitiated, it is not enough to ease the part pained, we must look further, and apply general correctives; otherwise the ill humour may soon show itself in some other part.

The South-sea affair, how sensible soever, is not the original evil, or the great source of our misfortunes, it is but the natural effect of those principles, which for many years have been propagated with great industry. And as a sharp distemper, by reclaiming a man from intemperance, may prolong his life, so it is not impossible but this public calamity that lies so heavy on the nation may prevent its ruin. It would certainly prove the greatest of blessings, if it should make all honest men of one party; if it should put religion and virtue in countenance, restore a sense of public spirit, and convince men it is a dangerous folly to

pursue private aims in opposition to the good of their country, if it should turn our thoughts from gousenage and stock-jobbing, to industry and frugal methods of life; in fine, if it should revive and inflame that native spark of British worth and honour, which hath too long lain smothered and oppressed.

With this view I have, among so many projects for remedying the ill state of our affairs in a particular instance, ventured to publish the foregoing general hints, which as they have been thrown together from a zeal for the public good, so I heartily wish they may be regarded neither more nor less, than as they are fitted to promote that end.

Though it must be owned, that little can be hoped if we consider the corrupt degenerate age we live in. I know it is an old folly to make peevish complaints of the times, and charge the common failures of human nature on a particular age. One may nevertheless venture to affirm, that the present hath brought forth new and portentous villanies, not to be paralleled in our own or any other history. We have been long preparing for some great catastrophe. Vice and villany have by degrees grown reputable among us; our infidels have passed for fine gentlemen, and our venal traitors for men of sense, who knew the world. We have made a jest of public spirit, and cancelled all respect for whatever our laws and religion repute sacred. The old English modesty is quite worn off, and instead of blushing for our crimes, we are ashamed only of piety and virtue. In short, other nations have been wicked, but we are the first who have been wicked upon principle.

The truth is, our symptoms are so bad, that notwithstanding all the care and vigilance of the legislature, it is to be feared the final period of our state approaches. Strong constitutions, whether politic or natural, do not feel light disorders. But, when they are sensibly affected, the distemper is for the most part violent and of an ill prognostic. Free governments like our own were planted by the Goths in most parts of Europe; and though we all know what they are come to, yet we seem disposed rather to follow their example, than to profit by it.

Whether it be in the order of things that civil states should have, like natural products, their several periods of growth, perfection, and decay; or whether it be an effect, as seems more probable, of human folly, that as industry produces wealth, so wealth should produce vice, and vice ruin.

God grant the time be not near, when men shall say, 'this island was once inhabited by a religious, brave, sincere people, of plain uncorrupt manners, respecting inbred worth rather than titles and appearances, assertors of liberty, lovers of their country, jealous of their own rights, and unwilling to infringe the rights of others; improvers of learning and useful arts, enemies to

luxury, tender of other men's lives, and prodigal of their own; inferior in nothing to the old Greeks or Romans, and superior to each of those people in the perfections of the other. Such were our ancestors during their rise and greatness; but they degenerated, grew servile flatterers of men in power, adopted epicurean notions, became venal, corrupt, injurious, which drew upon them the hatred of God and man, and occasioned their final ruin.'

A DISCOURSE,

ADDRESSED TO

MAGISTRATES AND MEN IN AUTHORITY:

OCCASIONED BY THE ENORMOUS LICENSE AND IRRELIGION OF THE TIMES.

A DISCOURSE.

THE pretensions and discourse of men throughout these kingdoms, would, at first view, lead one to think the inhabitants were all politicians; and yet, perhaps, political wisdom hath, in no age or country, been more talked of and less understood. License is taken for the end of government, and popular humour for its origin. No reverence for the laws, no attachment to the constitution, little attention to matters of consequence, and great altercation upon trifles, such idle projects about religion and government, as if the public had both to choose, a general contempt of all authority, divine and human, an indifference about the prevailing opinions, whether they tend to produce order or disorder, to promote the empire of God or the devil: these are the symptoms that strongly mark the present age; and this could never have been the case, if a neglect of religion had not made way for it.

When the Jews accused Paul upon religious matters and points of their law before Gallio, the Roman magistrate, it is said, that Gallio "cared for none of those things." And it is to be feared, there are not a few magistrates in this Christian country, who think with the same indifference on the subject of religion. Herein, nevertheless, they judge amiss, and are much wanting to their duty. For, although it be admitted, that the magistrate's peculiar object is the temporal welfare of the state; yet this will by no means exclude a proper care about the prevailing notions and opinions of religion, which influence the lives and actions of men, and have therefore a mighty effect on the public. Men's behaviour is the consequence of their principles. Hence it follows, that in order to make a state thrive and flourish, care must be taken that good principles be propagated in the minds of those who compose it.

It would be vain to depend on the outward form, the constitution and structure of a state, while the majority are ever governed by their inward ways of thinking, which at times will break out and show themselves paramount to all laws and institutions whatsoever. It must be great folly therefore to overlook notions, as matters of small moment to the state; while experience shows there is nothing more important; and that a prevailing disorder in the principles and opinions of its members, is ever dangerous to society, and capable of producing the greatest public evils.

Man is an animal, formidable both from his passions and his reason; his passions often urging him to great evils, and his reason furnishing means to achieve them. To tame this animal, and make him amenable to order, to inure him to a sense of justice and virtue, to withhold him from ill courses by fear, and encourage him in his duty by hopes; in short, to fashion and model him for society, hath been the aim of civil and religious institutions; and in all times, the endeavour of good and wise men. The aptest method for attaining this end, hath been always judged a proper education.

If men's actions are an effect of their principles, that is, of their notions, their belief, their persuasions; it must be admitted, that principles early sown in the mind, are the seeds which produce fruit and harvest in the ripe state of manhood. How lightly soever some men may speak of notions, yet so long as the soul governs the body, men's notions must influence their actions, more or less, as they are stronger or weaker; and to good or evil, as they are better or worse.

Our notions and opinions are a constant check on our appetites, and balance to our passions; and although they may not in every instance control and rule, yet they will never fail strongly to affect both the one and the other. What is it that bridles the impetuous desires of men? that restrains them when they are driven by the most violent passions? In a word, what is it that renders this world habitable, but the prevailing notions of order, virtue, duty, and providence? Some perhaps may imagine, that the eye of the magistrate alone is sufficient to keep mankind in awe. But if every man's heart was set to do all the mischief his appetite should prompt him to do, as often as opportunity and secresy presented themselves, there could be no living in the world.

And although too many of those entrusted with civil power, in these our days, may be said with Gallio, to "care for none of those things;" and many more who would pass for men of judgment and knowledge, may look on notions early imbibed, before their grounds and reasons are apprehended or understood, to be but mere prejudices; yet this will detract nothing from their truth and usefulness. To place this matter in a due light, I propose to show, that a system of salutary notions, is absolutely necessary to the support of every civil constitution. I shall enforce this point by the testimony of those who are esteemed the wisest men; and I shall make some remarks on the modern prevailing spirit, and the tendency of the maxims of our times.

Order is necessary, not only to the well-being, but to the very being of a state. Now, order and regularity in the actions of men, is not an effect of appetite or passion, but of judgment: and the judgment is governed by notions or opinions. There

must, therefore, of necessity, in every state, be a certain system of salutary notions, a prevailing set of opinions, acquired either by private reason and reflection, or taught or instilled by the general reason of the public; that is, by the law of the land. True it is, that where men either cannot, or will not use their own reason, think and examine for themselves; in such case, the notions taught and instilled into their minds are embraced rather by the memory than the judgment. Nor will it be any objection to say, that these are prejudices; inasmuch as they are therefore neither less useful, nor less true, although their proofs may not be understood by all men.

Licentious habits of youth give a cast or turn to age: the young rake makes an old infidel: libertine practices beget libertine opinions: and a vicious life generally ends in an old age of prejudice not to be conquered by reasoning. Of this we see instances even in persons celebrated for parts, and who reason admirably on other points where they are not biassed; but on the subject of religion obtrude their guesses, surmises, and broken hints for arguments. Against such there is no reasoning.

Prejudices are notions, or opinions, which the mind entertains without knowing the grounds and reasons of them, and which are assented to without examination. The first notions which take possession of the minds of men, with regard to duties social, moral, and civil, may therefore be justly styled prejudices. The mind of a young creature cannot remain empty; if you do not put into it that which is good, it will be sure to receive that which is bad.

Do what you can, there will still be a bias from education; and if so, is it not better this bias should lie towards things laudable and useful to society? This bias still operates, although it may not always prevail. The notions first instilled have the earliest influence, take the deepest root, and generally are found to give a colour and complexion to the subsequent lives of men, inasmuch as they are in truth the great source of human actions. It is not gold, or honour, or power, that move men to act, but the opinions they entertain of those things. Hence it follows, that if a magistrate should say, no matter what notions men embrace, I will take heed to their actions; therein he shows his weakness; for, such as are men's notions, such will be their deeds.

For a man to do as he would be done by; to love his neighbour as himself; to honour his superiors; to believe that God scans all his actions, and will reward or punish them; and to think that he who is guilty of falsehood, or injustice, hurts himself more than any one else: are not these such notions, and principles, as every wise governor, or legislator, would covet above all things, to have firmly rooted in the mind of every individual under his care? This is allowed, even by the enemies of religion,

who would fain have it thought the offspring of state policy, honouring its usefulness at the same time that they disparage its truth. What, therefore, cannot be acquired by every man's reasoning, must be introduced by precept, and riveted by custom; that is to say, the bulk of mankind must, in all civilized societies, have their minds by timely instruction, well seasoned and furnished with proper notions, which, although the grounds or proofs thereof be unknown to them, will nevertheless influence their conduct, and so far render them useful members of the state. But, if you strip men of these their notions, or, if you will, prejudices, with regard to modesty, decency, justice, charity, and the like, you will soon find them so many monsters, utterly unfit for human society.

I desire it may be considered, that most men want leisure, opportunity, or faculties, to derive conclusions from their principles, and establish morality on a foundation of human science. True it is, as St. Paul observes, that "the invisible things of God, from the creation of the world, are clearly seen."* And from thence the duties of natural religion may be discovered. But these things are seen and discovered by those alone who open their eyes, and look narrowly for them. Now, if you look throughout the world, you shall find but few of these narrow inspectors and inquirers, very few who make it their business to analyze opinions and pursue them to their rational source, to examine whence truths spring, and how they are inferred. In short, you shall find all men full of opinions, but knowledge only in a few.

It is impossible from the nature and circumstances of human kind, that the multitude should be philosophers, or that they should know things in their causes. We see every day, that the rules, or conclusions alone, are sufficient for the shopkeeper to state his account, the sailor to navigate his ship, or the carpenter to measure his timber; none of which understand the theory, that is to say, the grounds and reasons either of arithmetic or geometry. Even so in moral, political, and religious matters, it is manifest, that the rules and opinions early imbibed at the first dawn of understanding, and without the least glimpse of science, may yet produce excellent effects, and be very useful to the world: and that in fact they are so, will be very visible to every one who shall observe what passeth round about him.

It may not be amiss to inculcate, that the difference between prejudices and other opinions doth not consist in this; that the former are false, and the latter true; but in this, that the former are taken upon trust, and the latter acquired by reasoning. He who hath been taught to believe the immortality of the soul, may be as right in his notion, as he who hath reasoned himself into

* Rom. i. 20

that opinion. It will then by no means follow, that because this or that notion is a prejudice, it must be therefore false. The not distinguishing between prejudices and errors, is a prevailing oversight among our modern free-thinkers.

There may be, indeed, certain mere prejudices or opinions, which having no reasons either assigned or assignable, to support them, are nevertheless entertained by the mind, because they intruded betimes into it. Such may be supposed false, not because they were early learned, or learned without their reasons; but because there are in truth no reasons to be given for them.

Certainly, if a notion may be concluded false, because it was early imbibed, or because it is with most men an object of belief rather than of knowledge, one may by the same reasoning conclude several propositions of Euclid to be false. A simple apprehension of conclusions as taken in themselves, without the deductions of science, is what falls to the share of mankind in general. Religious awe, the precepts of parents and masters, the wisdom of legislators, and the accumulated experience of ages, supply the place of proofs and reasonings with the vulgar of all ranks: I would say, that discipline, national constitution, and laws human or divine, are so many plain land marks, which guide them into the paths wherein it is presumed they ought to tread.

From what hath been premised, it plainly appears, that in the bulk of mankind, there are, and must be prejudices; that is, opinions taken upon trust: or, in other words, that there are points of faith among all men, whatsoever, as well as among Christians.

And, as it is evident, that the unthinking part of every age, sex, and condition among us, must necessarily receive notions with the submission of faith; so it is very reasonable, that they should submit their faith to the greatest authorities human and divine, the law and the gospel. But, if once all reverence for these be destroyed, our pretenders to moral knowledge will have no authority to imbue the multitude with such notions as may control their appetites. From all which it follows, that the modern schemes of our free-thinkers, who pretend to separate morality from religion, how rational soever they may seem to their admirers, are, in truth and effect, most irrational and pernicious to civil society.

Let any one, who thinks at all, consider the savage state of undisciplined men, whose minds are nurtured to no doctrine, broke by no instruction, governed by no principle. Let him at the same time reflect on a society of persons educated in the principles of our church, formed betimes to fear God, to reverence their superiors, to be grateful to their benefactors, forgiving to their enemies, just and charitable to all men; and he will then be able to judge of the merits of those who are so active to weed out the prejudices of education.

Among the many wild notions broached in these giddy times, it must be owned, that some of our declaimers against prejudice, have wrought themselves into a sort of esteem for savages, as a virtuous and unprejudiced people. In proof of which, they allege their being free from many vices practised in civilized nations. Now, it is very true, among savages there are few instances to be found of luxury, avarice, or ambition: not that the contrary virtues take place, but because the opportunities and faculties for such vices, are wanting. For the same reason you do not see them in brutes.

What they esteem and admire in those creatures is not innocence, but ignorance: it is not virtue, but necessity. Give them but the means of transgressing, and they know no bounds. For example: supply the water drinking savage with strong liquor, and he shall be drunk for several days and nights together. Again: we admit an uneducated savage knows not how to supplant a rival with the refined treachery of a courtier; yet, if you put his foe once in his power, you shall soon see what a horrible relish and delight the monster hath in cruelty.

Above all others, religious notions, or, if you will, prejudices (since this, as hath been already observed, detracts nothing from their truth and usefulness) have the most influence, they are the strongest curb from vice, and the most effectual spur to worthy conduct. And indeed, whether we consider the reason of things, or the practice of men in all times, we shall be satisfied that nothing truly great and good can enter into the heart of one attached to no principles of religion, who believes no Providence, who neither fears hell, nor hopes for heaven.

Punishments and rewards have always had, and always will have, the greatest weight with men; and the most considerable of both kinds are proposed by religion, the duties whereof fall in with the views of the civil magistrate; it undeniably follows that nothing can add more strength to a good and righteous government than religion. Therefore it mainly concerns governors to keep an attentive eye on the religion of their subjects. And indeed, it is one lesson to magistrate and people, prince and subject, "Keep my commandments and live, and my law as the apple of thine eye."*

Although it is no consequence, from what hath been said, that men should be debarred the free use of reason and inquiry; yet surely it will follow, that without good reason a man should not reject those notions which have been instilled by the laws and education of his country. And even they who think they have such reason have nevertheless no right of dictating to others.†

* Prov. vii. 3.

† Though a man's private judgment be a rule to himself, it will not thence follow, that he hath any right to set it up for a rule to others.

It is true divine authority is superior to all human prejudices, institutions, and regards whatsoever. And it is wise, although at the risk of liberty or life, to obey God rather than man. But our modern reformers of prejudice have nothing to plead* of that kind.

There is no magistrate so ignorant as not to know that power, physical power, resides in the people; but authority is from opinion, which authority is necessary to restrain and direct the people's power, and therefore religion is the great stay and support of a state. Every religion that inculcates virtue, and discourageth vice, is so far of public benefit. The Christian religion doth not only this, but further makes every legal constitution sacred by commanding our submission thereto. "Let every soul be subject to the higher powers," saith St. Paul; "for the powers that be are ordained of God."† And in effect, for several years past, while the reverence for our church and religion hath been decaying and wearing off from the minds of men, it may be observed, that loyalty hath in proportion lost ground; and now the very word seems quite forgotten. Submission for conscience, as well as for wrath, was once reckoned an useful lesson; but now, with other good lessons, is laid aside as an obsolete prejudice.

That prince or magistrate, however great or powerful, who thinks his own authority sufficient to make him respected and obeyed, lies under a woful mistake, and never fails to feel it sooner or later. Obedience to all civil power is rooted in the religious fear of God; it is propagated, preserved, and nourished by religion. This makes men obey, not with eye-service, but in sincerity of heart. Human regards may restrain men from open and penal offences; but the fear of God is a restraint from all degrees of all crimes, however circumstanced. Take away this stay and prop of duty, this root of civil authority; and all that was sustained by it, or grew from it, shall soon languish. The authority, the very being of the magistrate, will prove a poor and precarious thing.

An inward sense of the supreme majesty of the King of kings, is the only thing that can beget and preserve a true respect for subordinate majesty in all the degrees of power, the first link of authority being fixed at the throne of God. But in these our days, that *majestas imperii*, that sacredness of character, which rooted in a religious principle, was the great guard and security of the state, is through want thereof become the public scorn. And indeed, what hold can the prince or magistrate have on the conscience of those who have no conscience? How can he build

* No man can say he is obliged in conscience, honour, or prudence, to insult the public wisdom, or to ridicule the laws under whose protection he lives.

† Rom. xiii. 1.

on the principles of such as have no principles? Or how can he hope for respect where God himself is neglected?

It is manifest, that no prince upon earth can hope to govern well, or even to live easy and secure, much less respected by his people, if he do not contribute by his example and authority, to keep up in their minds an awful sense of religion. As for a moral sense and moral fitness, or eternal relations, how insufficient those things are for establishing general and just notions of morality, or for keeping men within due bounds, is so evident from fact and experience, that I need not now enter into a particular disquisition about them.*

It must be owned, that the claws of rapine and violence may in some degree be pared and blunted by the outward polity of a state. But should we not rather try, if possible, to pull them quite out? The evil effects of wickedness may be often redressed by public justice. But would it not be better to heal the source, and by an inward principle extirpate wickedness from the heart, rather than depend altogether on human laws for preventing or redressing the bad effects thereof? "I might," said the Chinese doctor Confucius, "hear and decide controversies as well as another: but what I would have is, that men should be brought to abstain from controversies, out of an inward love and regard for each other."†

Too many in this age of free remarks and projects are delighted with republican schemes, and imagine they might remedy whatever was amiss, and render a people great and happy, merely by a new plan or form of government. This dangerous way of thinking and talking is grown familiar, through the foolish‡ freedom of the times. But, alas! those men do not seem to have touched either the true cause or cure of public evils. Be the plan ever so excellent, or the architects ever so able, yet no man in his wits would undertake to build a palace with mere mud or dirt. There must be fit materials; and without a religious principle men can never be fit materials for any society, much less for a republic. Religion is the centre which unites, and the cement which connects the several parts or members of the political body. Such it hath been held by all wise men, from the remotest times, down to our ingenious contemporaries; who, if they are in the right, it must be admitted that all the rest of the world have been in the wrong.

From the knowledge of its being absolutely necessary to the government of a state, that the hearts and minds of the people be inwardly imbued with good principles, Plato§ tells, that "Jupiter, to preserve the race of men from perishing, sent Mercury

* See Alciphron, dial. iii. and iv. † Scientia Sin. lib. i. fol. 12.

‡ Men forget that liberty consists in a mean, or that there is any other extreme beside tyranny. § In Protagora.

with orders to introduce modesty and justice among them, as the firmest ties of human society, and without which it could not subsist." And elsewhere the same author gives it plainly as his sense,* that "concerning those great duties which men's appetites and passions render difficult, it should seem rather the work of God to provide than of human legislators, if it were possible to hope for a system of laws framed and promulgated by God himself." You see how agreeable the Mosaic and Christian institutions are to the wishes of the wisest heathen.

Moses, indeed, doth not insist on a future state, the common basis of all political institutions. Nor do other lawgivers make a particular mention of all things necessary, but suppose some things as generally known or believed. The belief of a future state (which it is manifest the Jews were possessed of long before the coming of Christ) seems to have obtained among the Hebrews from primeval tradition; which might render it unnecessary for Moses to insist on that article. But the Sadducees and Epicureans had, in progress of time, gone so far towards rooting out this ancient and original sentiment, that it was in danger of being lost, had it not been taught and promulgated in a new light by our blessed Saviour.

But many among us who would pass for assertors of truth and liberty are accustomed to rail at this, and all other established opinions, as prejudices which people are taught whether they will or no, and before they are able to distinguish whether they are right or wrong. These lovers of truth would do well to consider, that in political, moral, and religious matters, the opinions of the vulgar, whether they go in coaches, or walk on foot, are for the most part prejudices; and are so like to be whatever side of the question they embrace; whether they follow the old maxims of the religion of their country, or the modern instructions of their new masters. I have already observed, that a point's being useful, and inculcated betimes, can be no argument of its falsehood, even although it should be a prejudice; far otherwise, utility and truth are not to be divided; the general good of mankind being the rule or measure of moral truth.†

I shall now add, that it is to be apprehended, many of those who are the most forward to banish prejudices would be the first to feel the want of them. It is even pitiful to think what would become of certain modern declaimers on that article, were prejudice really set aside, and were all men to be weighed in the exact scale of merit, and considered in proportion only to their intrinsic worth. Some prejudices are grounded in truth, reason, and nature: such are the respects which are paid to knowledge, learning, age, honesty, and courage, in all civilized countries. Others are purely the effect of particular constitutions; such are the

* De Legibus, lib. viii. † See Alciphron, dial. i. sect. 16.

respects, rights, and preeminences ascribed to some men by their fellow-subjects, on account of their birth and quality; which, in the great empires of Turkey and China, pass for nothing; and will pass for nothing elsewhere as soon as men have got rid of their prejudices, and learned to despise the constitutions of their country. It may behove those who are concerned to reflect on this betimes.

God, comprehending within himself the beginning, end, and middle of all things and times, exerts his energy throughout the whole creation. He never ceaseth to influence by instinct, by the light of nature, by his declared will. And it is the duty of magistrates and lawgivers to cultivate and encourage those divine impressions in the minds of all men under their care. We are not to think it is the work of God, and therefore not to be seconded by human care. Far otherwise, for that very reason it claims our utmost care and diligence, it being the indispensable duty of all good men, throughout the whole course of their lives, to co-operate with the designs of Providence. In religion, as in nature, God doth somewhat, and somewhat is to be done on the part of man. He causes the earth to bring forth materials for food and raiment; but human industry must improve, prepare, and properly apply both the one and the other, or mankind may perish with cold and hunger. And according to this same analogy,* the principles of piety and religion, the things that belong to our salvation, although originally and primarily the work of God, yet require the protection of human government, as well as the furtherance and aid of all wise and good men.

And if religion in all governments be necessary, yet it seems to be so more especially in monarchies: forasmuch as the frugal manners, and more equal fortunes in republics, do not so much inflame men's appetites, or afford such power or temptation to mischief, as the high estate and great wealth of nobles under a king. Therefore, although the magistrate (as was already observed) hath for his peculiar object the temporal well-being of the state; yet this will by no means exempt him from a due concern for the religion of his country.

What was the sense of our ancestors on this point appears throughout the whole constitution of these kingdoms; and in order to justify this constitution, and the wisdom of those who framed it, I shall crave leave to make use of some unsuspected testimonies, ancient and modern, which will show, that the public care of a national religion, hath been always a most principal point in the esteem of wise men, however run down by the prevailing license of our times.

* It will be sufficient, if such analogy appears between the dispensations of grace and nature as may make it probable to suppose them derived from the same author.—Alciphron, dial. vi. sect. 31.

The first testimony I shall produce is that of Zaleucus, the famous lawgiver of the Locrians; who, in his preamble to his laws,* begins with religion, laying it down as the corner-stone, or foundation of his whole superstructure, "That every inhabitant subject of the state should be persuaded that there is a God and divine providence: that the only way of becoming dear to God is by endeavouring, above all things, to be good, both in deed and in will: that a worthy citizen is one that prefers integrity to wealth." He further admonishes those who are difficult to persuade, "To bethink themselves of God's providence, and the punishments that await evil-doers; and in all their actions to be ever mindful of the last day, as if it were present, or in case the devil† should tempt a man to sin, he exhorts such a one to frequent the temples and altars, worshipping and imploring the divine assistance."

Aristotle,‡ discoursing of the means to preserve a monarchy, admonishes the supreme magistrate above all things to show himself zealous in religious matters; and this particularly for two reasons. "1. Because the subjects will have less to fear from one who fears God. 2. Because they will be less apt to rebel against him whom they take to be the favourite of heaven." And elsewhere this same philosopher recommends the worship of the gods as the first care of the state.§

Plato likewise begins his laws with the care of religious rites. He even maintains religion, or divine worship, to be the chief aim and scope of human life.‖

Hippodamus the Milesian,¶ in his scheme of a republic, allotted a third part of the land for maintaining divine worship.**

The Roman historians and poets do so abound with passages ascribing the successes of their government to religion, and its declension to the want or neglect thereof, that it may seem impertinent to enter into a detail of what every schoolboy knows.

To come from ancient to modern authority, Machiavel himself represents religion as absolutely necessary to maintain civil order and government. He observes, that for many years there was a most awful sense of religion in the old Romans; and that this did much facilitate their great undertakings. He likewise observes, and shows by divers instances, that the Romans were more afraid to break an oath than to transgress the laws; and that those things which even the love of their country and constitution could not bring them to, they were brought to through

* Stobæus de Leg. et Consuet. ser. 145.

† Δαίμων κακὸς. ‡ De Republ. lib. v. § Ibid. lib. vii. cap. 17.

‖ De Leg. lib. iv. et vi. ¶ Arist. de Republ. lib. ii. cap. 8.

** The abolishing of the Christian religion, upon a frugal principle, must be bad policy, if we may judge what will be by what hath been in the great pagan states of antiquity, whose religions, upon a fair estimate, will be found to have been more expensive.

a sense of religion. Upon the whole, he concludes, that old Rome was more obliged to Numa, who established a national religion, than to Romulus himself, the founder of that state.*

And here, by the by, I shall take notice, that some may imagine, the various forms and institutions of religion ought to unsettle men's minds with regard to the truth and certainty of any. But this matter rightly considered will, I think, produce a contrary effect. It showeth, indeed, that men groping out their way by the dim twilight of nature did only approach, some nearer, some farther off, while all were short of the truth. But then it showeth likewise, upon the whole, and in general, that religion is so natural to our minds, so useful to society, and of so necessary importance to the world, as might well prove its truth, and render it worthy of the divine care to propagate by prophecies, miracles, and the mission of the Son of God.

Philip de Comines,† a wise statesman and honest writer, who had great experience in affairs, declares it to be his opinion, "That want of religious faith is the only fountain of all mischiefs."

And that able minister, the famous Monsieur Colbert,‡ makes it his observation, "That if once the ecclesiastical character, as such, is vilified, the civil magistrate, even the crown itself, will, in consequence thereof, lose all authority."

It would be no hard matter to produce a cloud of testimonies in behalf of a national religion, from the most eminent of our own writers; but I shall content myself with adding one only, and that from a very unsuspected writer, Mr. Harrington, author of the Oceana, who shows that to be just and fair which others have shown to be expedient. "A man," saith he, "that, pleading for liberty of conscience, refuseth liberty to the national conscience, must be most absurd."§ And again: "If the conviction of a man's private conscience produces his private religion, the conviction of the national conscience must produce a national religion."‖

All these authorities are taken from thinking men and able politicians, none of which can be supposed to say what he did not really think; and it had been very easy to have increased the number. But I am sorry I was obliged to mention any at all, in proof of so plain and fundamental a point as that of a national religion. It is, indeed, a shameful necessity we lie under, of proving at this time of day the first elements, I will not say of Christianity, but even of natural light, from reasons and from authorities. The spirit of the times hath rendered this unavoidable.

If it should be asked, after all, how comes it then to pass that

* Discorsi, lib. i. cap. 12. † Hist. b. v. ‡ Test. Pol. cap. 8.
§ P. 27, first edit. ‖ Ibid.

the fashionable and prevailing maxims among our betters, in a neighbouring nation, should run directly counter to all such reasons and authorities? I will answer this question by asking, when were our neighbours known to abound to that degree in highwaymen, murderers, housebreakers, incendiaries? When did such numbers lay violent hands on themselves? When was there such a general and indecent contempt of whatever is esteemed sacred, in the state as well as the church? When were there known among them such public frauds, such open confederacies in villany, as the present age hath produced? When were they lower in the esteem of mankind, more divided at home, or more insulted abroad?

We of this land have a fatal tendency to overlook the good qualities, and imitate whatever is amiss, in those whom we respect. This leads me to make some remarks on the modern spirit of reformation that works so strongly in both these kingdoms.

Freedom of thought is the general plea and cry of the age; and we all grant, that thinking is the way to know; and the more real knowledge there is in the land the more likely it will be to thrive. We are not therefore against freedom of thought, but we are against those unthinking, overbearing people,* who, in these odd times, under that pretence, set up for reformers and new moulders of the constitution. We declare against those who would seduce ignorant and unexperienced persons from the reverence they owe to the laws and religion of their country; and under the notion of extirpating prejudices, would erase from their minds all impressions of piety and virtue, in order to introduce prejudices of another kind, destructive of society.

We esteem it a horrible thing to laugh at the apprehensions of a future state, with the author of the Characteristics;† or with him who wrote the Fable of the Bees, to maintain that "moral virtues are the political offspring which flattery begot upon pride;"‡ that "in morals there is no greater certainty than in fashions of dress;"§ that, indeed, "the doctrine of good manners teacheth men to speak well of all virtues; but requires no more of them in any age or country than the outward appearance of those in fashion."‖ Two authors of infidel systems these, who setting out upon opposite principles, are calculated to draw all mankind, by flattering either their vanity or their passions, into one or other system. And yet the people among whom such books are published, wonder how it comes to pass that the civil

* It is not reason, candidly proposed, that offends; but the reviling, insulting, ridiculing of the national laws and religion. All this profiteth for free-thinking, and must needs be offensive to all reasonable men. † Vol. iii. Miscel. iii. c. 2.

‡ Inquiry into the Origin of Moral Virtue, ed. vi. p. 37.

§ The author's remarks on his Fable of the Bees, p. 379.

‖ Remarks, part ii. p. 155.

magistrate daily loseth his authority, that the laws are trampled upon, and the subject in constant fear of being robbed, or murdered, or having his house burnt over his head?

It may be presumed that the science of finding fault, which above all others is easiest to learn, suits best with a modern education. Too many there are of better fortunes than understandings, who have made the inquiry after truth a very small part of their care: these see somewhat, but not enough. It were to be wished, they knew either less or more. One thing it is evident they do not know; to wit, that while they rail at prejudice they are undoing themselves: they do not comprehend (what hath been before hinted) that their whole figure, their political existence, is owing to certain vulgar prejudices, in favour of birth, title, or fortune, which add nothing of real worth either to mind or body; and yet cause the most worthless person to be respected.

Freedom of thought is the prerogative of human kind; it is a quality inherent in the very nature of a thinking being. Nothing is more evident, than that every one can think his own way, in spite of any outward force or power whatsoever. It is therefore ridiculous for any man to declaim in defence of a privilege which cannot be denied or taken from him. But this will not infer a boundless freedom of speech,* an open contempt of laws, and a prescribing from private judgment† against public authority: things never borne in any well-ordered state, and which make the crying distemper of our times.

I am sensible, that whatever looks like a restraint on freedom of inquiry, must be very disagreeable to all reasoning and inquisitive men. But against this, I have said nothing.‡ On the contrary, I will freely own, a judicious and impartial search after truth, is the most valuable employment of the mind. Those who have the talents, and will be at the pains, cannot do better than engage in that noble pursuit. But those who are not qualified by age or education; those who have neither disposition, nor leisure, nor faculties to dig in the mine of truth themselves, must take it retailed out by others. I see no remedy. God who knows the opportunities of every man, requires impossibilities from no man. And where there is a sincere love of truth and virtue, the grace of God can easily supply the defect of human means.

It hath been before observed, and showed at large, that the bulk of mankind must have their minds betimes imbued with

* Is there no difference between indulging scrupulous consciences, and tolerating public deriders of all conscience and religion?

† A man who is himself permitted to follow his own private judgment cannot well complain, although he may not set it up as a public rule.

‡ The profane and lawless scorner is one thing, and the modest inquirer after truth another.

good and wholesome notions or principles, by their parents, pastors, and tutors, or else bad notions, hurtful to themselves and others, will undoubtedly take possession thereof. Such bad notions have, for several years past, been propagated with uncommon industry in these kingdoms: they now bring forth fruit every day more and more abundant. It is to be feared, that what hath been long ripening, is now near ripe. Many are the signs and tokens. He that runs may read.

But there cannot be a higher, or more flagrant symptom of the madness of our times, than that execrable fraternity of blasphemers, lately set up within this city of Dublin. Blasphemy against God is a great crime against the state. But that a set of men should, in open contempt of the laws, make this very crime their profession, distinguish themselves by a peculiar name,* and form a distinct society, whereof the proper and avowed business shall be, to shock all serious Christians by the most impious and horrid blasphemies, uttered in the most public manner: this surely must alarm all thinking men. It is a new thing under the sun reserved for our worthy times and country.

It is no common blasphemy I speak of: it is not simple cursing and swearing: it is not the effect either of habit or surprise; but a train of studied deliberate indignities against the divine majesty; and those of so black and hellish a kind, as the tongues alone which uttered them, can duly characterise and express. This is no speculative heresy, no remote or doubtful inference from an author's tenets: it is a direct and open attack on God himself. It is such a calm premeditated insult upon religion, law, and the very light of nature, that there is no sect or nation of men, whether Christians, Jews, Mahometans, or even civilized heathens, that would not be struck with horror and amazement at the thought of it, and that would not animadvert† on its authors with the utmost severity.

Deliberate, atheistical blasphemy, is of all crimes most dangerous to the public, inasmuch as it opens the door to all other crimes, and virtually contains them all. A religious awe and fear of God, being (as we have already observed) the centre that unites, and the cement that connects all human society. He who makes it his business to lessen or root out from the minds of men this principle, doth in effect endeavour to fill his country with highwaymen, house-breakers, murderers, fraudulent dealers, perjured witnesses, and every other pest of society. Therefore, it would be the greatest cruelty to our children, neighbours, and country, to connive at such a crime; a crime! which hath no

* Blasters.

† They (if there be any such) who think to serve the Reformation, by joining with blasters and devil-worshippers in a plea for license, are in truth a scandal and reproach to the Protestant cause.

natural passion or temptation to plead for it, but is the pure effect of an abandoned impudence in wickedness; and, perhaps, of a mistaken hope, that the laws and magistrates are asleep.

The question is not now, whether religion shall be established by law: the thing is already done, (and done with good reason, as appeareth from the premises) but whether a reverence* for the laws shall be preserved. Religion, considered as a system of saving truths, hath its sanction from heaven; its rewards and penalties are divine. But religion, as useful and necessary to society, hath been wisely established by law; and so established, and wrought into the very frame and principles of our government, is become a main part of the civil constitution. Our laws are the laws of a Christian country: our government hath been constituted and modelled by Christians; and is still administered and maintained by men professing belief in Christ. Can it then be supposed, that impious men shall with impunity, invent and †publicly utter the most horrid blasphemies: and at the same time, the whole constitution not be endangered? Or can it be supposed that magistrates, or men invested with power, should look on, and see the most sacred part of our constitution trampled under foot, and yet imagine their own dignity and authority to be secure, which rest entirely thereupon? I will venture to say, that whoever is a wise man, and a lover of his country, will not only be solicitous to preserve the honour of God sacred and entire; he will even discourage that prevailing prejudice against the dispensers of God's word, the teachers of those salutary doctrines, without which the public cannot thrive or subsist. He will be no contemner, not even of those rites and ordinances enjoined by law, as necessary to imprint and retain a sense of religion in the minds of men. He will extend his care to the outworks, as knowing that when these are gone, it may be difficult to preserve the rest.

Notwithstanding the vain assertion of those men, who would justify the present, by saying "all times are alike," it is most evident, that the magistrates, the laws, the very constitution of these realms, have lost no small share of their authority and reverence, since this great growth and spreading of impious principles. Whatever be the cause, the effect is apparent. Whether we ascribe it to the natural course of things, or to a just judgment upon those, who, having been careless to preserve a due sense of the divine authority, have seen and shall see their own despised.

* They who plead a right to contradict the laws, can pretend none for doing it with insolence or disrespect.

† To make the cause of such men the cause of liberty or toleration would be monstrous. A man is not suffered publicly to blaspheme, therefore he may not think freely: a profane miscreant is not indulged in the public worship of the devil, therefore a conscientious person may not serve God his own way: is not this absurd?

Darius, a heathen prince, made a decree, that in every dominion of his kingdom, men should tremble and fear before God.* Nebuchadnezzar likewise, another heathen, made a decree, that every people, nation, and language which spoke any thing amiss against God should be cut in pieces, and their houses made a dunghill† And if these things were done in Persia and Babylon, surely it may be expected, that impious blasphemers against God, and his worship, should at least be discouraged and put out of countenance in these Christian countries. Now, a constant course of disfavour from men in authority, would prove a most effectual check to all such miscreants. When therefore they are public and bold in their blasphemies, this is no small reflection on those who might check them if they would.

It is not so much the execution of the laws, as the countenance of those in authority, that is wanting to the maintenance of religion. If men of rank and power, who have a share in distributing justice, and a voice in the public councils, shall be observed to neglect divine worship themselves, it must needs be a great temptation for others to do the same. But if they and their families should set a good example, it may be presumed, that men of less figure would be disposed to follow it. Fashions are always observed to descend, and people are generally fond of being in the fashion; whence one would be apt to suspect, the prevailing contempt of God's word, and estrangement from his house, to a degree that was never known in any Christian country, must take its rise from the irreligion and bad example of those who are styled *the better sort.*

Offences must come, but woe be to him by whom the offence cometh. A man who is entrusted with power and influence in his country, hath much to answer for, if religion and virtue suffer through want of his authority and countenance. But in case he should, by the vanity of his discourse, his favour to wicked men, or his own apparent neglect of all religious duties, countenance what he ought to condemn, and authorise by his own example what he ought to punish; such a one, whatever he may pretend, is, in fact, a bad patriot, a bad citizen, and a bad subject, as well as a bad Christian.

Our prospect is very terrible, and the symptoms grow stronger every day. The morals of a people are in this, like their fortunes; when they feel a national shock, the worst doth not show itself immediately. Things make a shift to subsist for a time, on the credit of old notions and dying opinions. But the youth born and brought up in wicked times, without any bias to good from early principle, or instilled opinion, when they grow

* Dan. vi. 26. † Dan. iii. 29.

ripe must be monsters indeed. And, it is to be feared, that age of monsters is not far off.

Whence this impiety springs, by what means it gains ground among us, and how it may be remedied, are matters that deserve the attention of all those who have the power and the will to serve their country. And although many things look like a prelude to general ruin; although it is much to be apprehended, we shall be worse before we are better; yet who knows what may ensue, if all persons in power, from the supreme executor of the law, down to a petty constable, would, in their several stations, behave themselves like men, truly conscious and mindful, that the authority they are clothed with, is but a ray derived from the supreme authority of heaven? This may not a little contribute to stem that torrent, which, from small beginnings, and under specious pretences, hath grown to such a head, and daily gathers force more and more to that degree, as threatens a general inundation and destruction of these realms.

A WORD TO THE WISE:

OR,

AN EXHORTATION

TO

THE ROMAN CATHOLIC CLERGY OF IRELAND.

A WORD TO THE WISE.

BE not startled, reverend sirs, to find yourselves addressed to by one of a different communion. We are indeed (to our shame be it spoken) more inclined to hate for those articles wherein we differ, than to love one another for those wherein we agree. But if we cannot extinguish, let us at least suspend our animosities, and forgetting our religious feuds, consider ourselves in the amiable light of countrymen and neighbours. Let us for once turn our eyes on those things, in which we have one common interest. Why should disputes about faith interrupt the duties of civil life? or the different roads we take to heaven prevent our taking the same steps on earth? Do we not inhabit the same spot of ground, breathe the same air, and live under the same government? Why then should we not conspire in one and the same design to promote the common good of our country?

We are all agreed about the usefulness of meat, drink, and clothes, and without doubt, we all sincerely wish our poor neighbours were better supplied with them. Providence and nature have done their part; no country is better qualified to furnish the necessaries of life, and yet no people are worse provided. In vain is the earth fertile, and the climate benign, if human labour be wanting. Nature supplies the materials, which art and industry improve to the use of man, and it is the want of this industry that occasions all our other wants.

The public hath endeavoured to excite and encourage this most useful virtue. Much hath been done; but whether it be from the heaviness of the climate, or from the Spanish or Scythian blood that runs in their veins, or whatever else may be the cause, there still remains in the natives of this island a remarkable antipathy to labour. You, gentlemen, can alone conquer their innate hereditary sloth. Do you then, as you love your country, exert yourselves.

You are known to have great influence on the minds of your people, be so good as to use this influence for their benefit. Since other methods fail, try what you can do. "Be instant in season, out of season, reprove, rebuke, exhort."* Make them thoroughly sensible of the sin and folly of sloth, Show your charity in clothing the naked, and feeding the hungry, which

* 2 Tim. iv. 2.

you may do by the mere breath of your mouths. Give me leave to tell you, that no set of men upon earth have it in their power to do good on easier terms, with more advantage to others, and less pains or loss to themselves. Your flock are of all others most disposed to follow directions, and of all others want them most; and indeed what do they not want?

The house of an Irish peasant is the cave of poverty; within you see a pot and a little straw; without, a heap of children tumbling on the dunghill. Their fields and gardens are a lively counterpart of Solomon's description in the Proverbs; "I went," saith that wise king, "by the field of the slothful, and by the vineyard of the man void of understanding, and lo! it was all grown over with thorns, and nettles had covered the face thereof, and the stone wall thereof was broken down."* In every road the ragged ensigns of poverty are displayed; you often meet caravans of poor, whole families in a drove, without clothes to cover, or bread to feed them, both which might be easily procured by moderate labour. They are encouraged in this vagabond life by the miserable hospitality they meet with in every cottage, whose inhabitants expect the same kind reception in their turn, when they become beggars themselves; beggary being the last refuge of these improvident creatures.

If I seem to go out of my province, or to prescribe to those who must be supposed to know their own business, or to paint the lower inhabitants of this land in no very pleasing colours, you will candidly forgive a well meant zeal, which obligeth me to say things, rather useful than agreeable, and to lay open the sore in order to heal it.

But whatever is said must be so taken, as not to reflect on persons of rank and education, who are no way inferior to their neighbours; nor yet to include all even of the lowest sort, though it may well extend to the generality, of those especially in the western and southern parts of the kingdom, where the British manners have less prevailed. We take our notions from what we see, mine are a faithful transcript from originals about me.

The Scythians were noted for wandering, and the Spaniards for sloth and pride; our Irish are behind neither of these nations from which they descend, in their respective characteristics. "Better is he that laboureth and aboundeth in all things, than he that boasteth himself and wanteth bread," saith the son of Sirach,† but so saith not the Irishman. In my own family a kitchen-wench refused to carry out cinders, because she was descended from an old Irish stock. Never was there a more monstrous conjunction than that of pride with beggary; and yet this prodigy is seen every day in almost every part of this king-

* Prov. xxiv. 30, 31. † Ch. x. 27.

dom. At the same time these proud people are more destitute than savages, and more abject than negroes. The negroes in our plantations have a saying, "If negro was not negro, Irishman would be negro." And it may be affirmed with truth, that the very savages of America are better clad and better lodged than the Irish cottagers throughout the fine fertile counties of Limerick and Tipperary.

Having long observed and bewailed this wretched state of my countrymen, and the insufficiency of several methods set on foot to reclaim them, I have recourse to your Reverences, as the *dernier resort*. Make them to understand that you have their interest at heart, that you persuade them to work for their own sakes, and that God hath ordered matters so as that they who will not work for themselves, must work for others. The terrors of debt, slavery, and famine should, one would think, drive the most slothful to labour. Make them sensible of these things, and that the ends of Providence and order of the world require industry in human creatures. "Man goeth forth to his work and to his labour until the evening," saith the psalmist, where here he is describing the beauty, order, and perfection of the works of God.* But what saith the slothful person? "Yet a little sleep, a little slumber, a little folding the hands to sleep."† But what saith the wise man? "So shall thy poverty come as one that travelleth, and thy want as an armed man."‡

All nature will furnish you with arguments and examples against sloth: "Go to the ant, thou sluggard," cries Solomon. The ant, the bee, the beetle, and every insect but the drone, reads a lesson of industry to man. But the shortest and most effectual lesson is that of St. Paul: "If any man will not work, neither should he eat."§ This command was enjoined the Thessalonians, and equally respects all Christians, and indeed all mankind; it being evident by the light of nature, that the whole creation works together for good, and that no part was designed to be useless; as therefore the idle man is of no use, it follows that he hath no right to a subsistence. "Let them work," saith the apostle, "and eat their own bread;"‖ not bread got by begging, not bread earned by the sweat of other men; but their own bread, that which is got by their own labour. "Then shalt thou eat the labour of thine hands," saith the psalmist, to which he adds, "Happy shalt thou be, and it shall be well with thee;"¶ intimating, that to work and enjoy the fruits thereof is a great blessing.

A slothful man's imagination is apt to dress up labour in a horrible mask; but horrible as it is, idleness is more to be dreaded, and a life of poverty (its necessary consequence) is far

* Psalm civ. 23. † Prov. vi. 10. ‡ Prov. vi. 11.
§ 2 Thess. iii. 10. ‖ 2 Thess. iii. 12. ¶ Psalm cxxviii. 2.

more painful. It was the advice of Pythagoras, to choose the best kind of life; for that use would render it agreeable, reconciling men even to the roughest exercise. By practice, pains become at first easy, and in the progress pleasant; and this is so true, that whoever examines things will find, there can be no such thing as a happy life without labour, and that whoever doth not labour with his hands, must in his own defence labour with his brains.

Certainly, planting and tilling the earth is an exercise not less pleasing than useful; it takes the peasant from his smoky cabin into the fresh air and the open field, rendering his lot far more desirable than that of the sluggard, who lies in the straw, or sits whole days by the fire.

Convince your people that not only pleasure invites, but necessity also drives them to labour. If you have any compassion for these poor creatures, put them in mind how many of them perished in a late memorable distress, through want of that provident care against a hard season, observable not only in all other men, but even in irrational animals. Set before their eyes in lively colours, their own indigent and sordid lives, compared with those of other people, whose industry hath procured them hearty food, warm clothes, and decent dwellings. Make them sensible what a reproach it is, that a nation which makes so great pretensions to antiquity, and is said to have flourished many years ago in arts and learning, should in these our days turn out a lazy, destitute, and degenerate race.

Raise your voices, reverend sirs, exert your influence, show your authority over the multitude, by engaging them to the practice of an honest industry, a duty necessary to all, and required in all, whether Protestants or Roman Catholics, whether Christians, Jews, or pagans. Be so good among other points to find room for this, than which none is of more concern to the souls and bodies of your hearers, nor consequently deserves to be more amply or frequently insisted on.

Many and obvious are the motives that recommend this duty. Upon a subject so copious you can never be at a loss for something to say. And while by these means you rescue your countrymen from want and misery, you will have the satisfaction to behold your country itself improved. What pleasure must it give you to see these wastes and wild scenes, these naked ditches and miserable hovels, exchanged for fine plantations, rich meadows, well tilled fields, and neat dwellings; to see people well fed and well clad, instead of famished, ragged scarecrows, and those very persons tilling the fields that used to beg in the streets.

Neither ought the difficulty of the enterprise to frighten you from attempting it. It must be confessed a habit of industry is

not at once introduced; neighbour, nevertheless, will emulate neighbour, and the contagion of good example will spread as surely as of bad, though perhaps not so speedily. It may be hoped, there are many that would be allured by a plentiful and decent manner of life to take pains, especially when they observe it to be attained by the industry of their neighbours, in no sort better qualified than themselves.

If the same gentle spirit of sloth did not soothe our squires as well as peasants, one would imagine there should be no idle hands among us. Alas! how many incentives to industry offer themselves in this island, crying aloud to the inhabitants for work? Roads to be repaired, rivers made navigable, fisheries on the coasts, mines to be wrought, plantations to be raised, manufactures improved, and, above all, lands to be tilled and sowed with all sorts of grain.

When so many circumstances provoke and animate your people to labour, when their private wants and the necessities of the public, when the laws, the magistrates, and the very country calls upon them, you cannot think it becomes you alone to be silent, or hindmost in every project for promoting the public good. Why should you, whose influence is greatest, be least active? why should you, whose words are most likely to prevail, say least in the common cause?

Perhaps it will be said, the discouragements attending those of your communion are a bar against all endeavours for exciting them to a laudable industry. Men are stirred up to labour by the prospect of bettering their fortunes, by getting estates or employments; but those who are limited in the purchase of estates, and excluded from all civil employments, are deprived of those spurs to industry.

To this it may be answered, that admitting these considerations do, in some measure, damp industry and ambition in persons of a certain rank, yet they can be no let to the industry of poor people, or supply an argument against endeavouring to procure meat, drink, and clothes. It is not proposed, that you should persuade the better sort to acquire estates, or qualify themselves for becoming magistrates; but only that you should set the lowest of the people at work, to provide themselves with necessaries, and supply the wants of nature.

It will be alleged in excuse of their idleness, that the country people want encouragement to labour, as not having a property in the lands. There is small encouragement, say you, for them to build, or plant upon another's land, wherein they have only a temporary interest. To which I answer, that life itself is but temporary; that all tenures are not of the same kind; that the case of our English and the original Irish is equal in this respect; and that the true aborigines, or natural Irish, are noted for want

of industry in improving even on their own lands, whereof they have both possession and property.

How many industrious persons are there in all civilized countries, without any property in lands, or any prospect of estates or employments? Industry never fails to reward her votaries. There is no one but can earn a little, and little added to little makes a heap. In this fertile and plentiful island none can perish for want but the idle and improvident. None who have industry, frugality, and foresight, but may get into tolerable, if not wealthy circumstances. Are not all trades and manufactures open to those of your communion? have you not the same free use, and may you not make the same advantage of fairs and markets as other men? do you pay higher duties, or are you liable to greater impositions than your fellow subjects? and are not the public premiums and encouragements given indifferently to artists of all communions? have not, in fact, those of your communion a very great share of the commerce of this kingdom in their hands? and is not more to be got by this than by purchasing estates, or possessing civil employments, whose incomes are often attended with large expenses?

A tight house, warm apparel, and wholesome food, are sufficient motives to labour. If all had them we should be a flourishing nation. And if those who take pains may have them, those who will not take pains are not to be pitied; they are to be looked on and treated as drones, the pest and disgrace of society.

It will be said, the hardness of the landlord cramps the industry of the tenant. But if rent be high, and the landlord rigorous, there is more need of industry in the tenant. It is well-known that in Holland taxes are much higher, and rent both of land and houses far dearer than in Ireland. But this is no objection or impediment to the industry of the people, who are rather animated and spurred on to earn a livelihood by labour, that is not to be got without it.

You will say, it is an easy matter to make a plausible discourse on industry and its advantages; but what can be expected from poor creatures, who are destitute of all conveniences for exerting their industry, who have nothing to improve upon, nothing to begin the world with? I answer, they have their four quarters, and five senses. Is it nothing to possess the bodily organs sound and entire? That wonderful machine, the hand, was it formed to be idle?

Was there but will to work, there are not wanting in this island either opportunities or encouragements. Spinning alone might employ all idle hands, children as well as parents, being soon learned, easily performed, and never failing of a market, requiring neither wit nor strength, but suited to all ages and capacities. The public provides utensils, and persons for teach-

ing the use of them; but the public cannot provide a heart and will to be industrious. These, I will not deny, may be found in several persons in some other parts of the kingdom, and wherever they are found the comfortable effects show themselves. But seldom, very seldom, are they found in these southern people, whose indolence figureth a lion in the way, and is proof against all encouragement.

But you will insist, how can a poor man, whose daily labour goes for the payment of his rent, be able to provide present necessaries for his family, much less to lay up a store for the future? It must be owned, a considerable share of the poor man's time and labour goes towards paying his rent. But how are his wife and children employed, or how doth he employ himself the rest of his time? The same work tires, but different works relieve. Where there is a true spirit of industry, there will never be wanting something to do, without doors or within, by candle-light, if not by day-light. "*Labor ipse voluptas,*" saith the poet, and this is verified in fact.

In England, when the labour of the field is over, it is usual for men to betake themselves to some other labour of a different kind. In the northern parts of that industrious land, the inhabitants meet, a jolly crew, at one another's houses, where they merrily and frugally pass the long and dark winter evenings; several families by the same light and the same fire, working at their different manufactures of wool, flax, or hemp; company meanwhile mutually cheering and provoking to labour. In certain other parts* you may see, on a summer's evening, the common labourers sitting along the streets of a town, or village, each at his own door, with a cushion before him, making bone-lace, and earning more in an evening's pastime than an Irish family would in a whole day. Those people, instead of closing the day with a game on greasy cards, or lying stretched before the fire, pass the time much more cheerfully in some useful employment, which custom hath rendered light and agreeable.

But admitting, for the various reasons above alleged, that it is impossible for our cottagers to be rich, yet it is certain they may be clean. Now bring them to be cleanly, and your work is half-done. A little washing, scrubbing, and rubbing, bestowed on their persons and houses, would introduce a sort of industry, and industry in any one kind is apt to beget it in another.

Indolence in dirt is a terrible symptom, which shows itself in our lower Irish more, perhaps, than in any people on this side the Cape of Good Hope. I will venture to add, that look throughout the kingdom, and you shall not find a clean house inhabited by cleanly people, and yet wanting necessaries; the same

* E. g. Newport Pagnel in Buckinghamshire.

spirit of industry that keeps folk clean, being sufficient to keep them also in food and raiment.

But alas! our poor Irish are wedded to dirt upon principle. It is with some of them a maxim, that the way to make children thrive is to keep them dirty. And I do verily believe, that the familiarity with dirt, contracted and nourished from their infancy, is one great cause of that sloth which attends them in every stage of life. Were children but brought up in an abhorrence of dirt, and obliged to keep themselves clean, they would have something to do, whereas they now do nothing.

It is past all doubt, that those who are educated in a supine neglect of all things, either profitable or decent, must needs contract a sleepiness and indolence, which doth necessarily lead to poverty, and every other distress that attends it. "Love not sleep," cries Solomon, "lest thou come to poverty, open thine eyes, and thou shalt be satisfied with bread."* It is therefore greatly to be wished, that you would persuade parents, to inure their children betimes to a habit of industry, as the surest way to shun the miseries that must otherwise befall them.

An early habit, whether of sloth or diligence, will not fail to show itself throughout the whole course of a man's life "Train up a child," saith the wise man, "in the way he should go, and when he is old he will not depart from it."† The first tincture often leaves so deep a stain as no after-thought or endeavour can wash out. Hence sloth in some minds is proof against all arguments and examples whatsoever, all motives of interest and duty, all impressions even of cold and hunger. This habit rooted in the child, grows up and adheres to the man, producing a general listlessness and aversion from labour. This I take to be our great calamity.

For admitting, that some of our 'squires and landlords are vultures with iron bowels, and that their hardness and severity is a great discouragement to the tenant, who will naturally prefer want and ease before want and toil; it must at the same time be admitted, that neither is the landlord, generally speaking, so hard, nor the climate so severe, nor the soil so ungrateful, as not to answer the husbandman's labour, where there is a spirit of industry; the want of which is the true cause of our national distress. Of this there are many evident proofs.

I have myself known a man, from the lowest condition of life, without friends or education, not knowing so much as to write or read, bred to no trade or calling, by pure dint of day-labour, frugality, and foresight, to have grown wealthy, even in this island, and under all the above mentioned disadvantages. And what is done by one, is possible to another.

* Prov. xx. 13. † Prov. xxii. 6

In Holland a child five years old is maintained by its own labour; in Ireland many children of twice that age do nothing but steal, or encumber the earth and dunghill. This shameful neglect of education shows itself through the whole course of their lives, in a matchless sloth bred in the very bone, and not to be accounted for by any outward hardship or discouragement whatever. It is the native colour, if we may so speak, and complexion of the people. Dutch, English, French, or Flemish cannot match them.

Mark an Irishman at work in the field; if a coach, or horseman go by, he is sure to suspend his labour, and stand staring until they are out of sight. A neighbour of mine made it his remark in a journey from London to Bristol, that all the labourers, of whom he inquired the road, constantly answered without looking up, or interrupting their work, except one who stood staring and leaning on his spade, and him he found to be an Irishman.

It is a shameful thing and peculiar to this nation, to see lusty vagabonds strolling about the country, and begging without any pretence to beg. Ask them why they do not labour to earn their own livelihood, they will tell you, They want employment; offer to employ them, and they shall refuse your offer; or, if you get them to work one day, you may be sure not to see them the next. I have known them decline even the lightest labour, that of hay-making, having at the same time neither clothes for their backs, nor food for their bellies.

A sore leg is an estate to such a fellow, and this may be easily got, and continued with small trouble. Such is their laziness, that rather than work they will cherish a distemper. This I know to be true, having seen more than one instance, wherein the second natures so far prevailed over the first, that sloth was preferred to health. To these beggars who make much of their sores, and prolong their diseases, you cannot do a more thankless office than cure them, except it be to shave their beards, which conciliate a sort of reverence to that order of men.

It is indeed a difficult task to reclaim such fellows from their slothful and brutal manner of life, to which they seem wedded with an attachment that no temporal motives can conquer; nor is there, humanly speaking, any hopes they will mend, except their respect for your lessons, and fear of something beyond the grave be able to work a change in them.

Certainly, if I may advise, you should in return for the lenity and indulgence of the government, endeavour to make yourselves useful to the public; and this will be best performed, by rousing your poor countrymen from their beloved sloth. I shall not now dispute the truth or importance of other points, but will venture to say, that you may still find time to inculcate this doctrine of

an *honest industry*, and that this would by no means be time thrown away, if promoting your country's interest, and rescuing so many unhappy wretches of your communion from beggary, or the gallows, be thought worth your pains.

It should seem you cannot in your sermons do better than inveigh against idleness, that extensive parent of many miseries and many sins; idleness, the mother of hunger and sister of theft; "idleness," which, the son of Sirach assures us, "teacheth many vices."

The same doctrine is often preached from the gallows. And indeed the poverty, nakedness, and famine which idleness entaileth on her votaries, do make men so wretched, that they may well think it better to die than to live such lives. Hence a courage for all villanous undertakings, which bringing men to a shameful death, do then open their eyes when they are going to be closed for ever.

If you have any regard (as it is not to be doubted) either for the souls or bodies of your people, or even for your own interest and credit, you cannot fail to inveigh against this crying sin of your country. Seeing you are obnoxious to the laws, should you not in prudence try to reconcile yourselves to the favour of the public; and can you do this more effectually, than by co-operating with the public spirit of the legislature, and men in power?

Were this but done heartily, would you but "be instant in season and out of season, reprove, rebuke, exhort," * such is the ascendant you have gained over the people, that we might soon expect to see the good effects thereof. We might hope that our garners would be soon full, affording all manner of store, that our sheep would bring forth thousands, that our oxen would be strong to labour, that there would be no breaking in nor going out" (no robbery, nor migration for bread), "and that there would be no complaining in our streets." †

It stands you upon to act with vigour in this cause, and shake off the shackles of sloth from your countrymen, the rather, because there be some who surmise, that yourselves have put them on. Right or wrong, men will be apt to judge of your doctrines by their fruits. It will reflect small honour on their teachers, if instead of honesty and industry those of your communion are peculiarly distinguished by the contrary qualities, or if the nation converted by the great and glorious St. Patrick should, above all other nations, be stigmatized and marked out as good for nothing.

I can never suppose you so much your own enemies, as to be friends to this odious sloth. But were this once abolished, and a laudable industry introduced in its stead, it may perhaps be asked,

* 2 Tim. iv. 2. † Ps. cxliv. 13, 14.

who are to be gainers? I answer, your reverences are like to be great gainers; for every penny you now gain, you will gain a shilling: you would gain also in your credit: and your lives would be more comfortable.

You need not be told, how hard it is to rake from rags and penury a tolerable subsistence; or how offensive to perform the duties of your function, amidst stench and nastiness; or how much things would change for the better, in proportion to the industry and wealth of your flocks. Duty as well as interest calls upon you to clothe the naked, and feed the hungry, by persuading them to "eat" (in the apostle's phrase) "their own bread," or, as the Psalmist expresseth it, "the labour of their own hands." By inspiring your flocks with a love of industry, you will at once strike at the root of many vices, and dispose them to practise many virtues. This therefore is the readiest way to improve them.

Consult your superiors. They shall tell you the doctrine here delivered is a sound catholic doctrine, not limited to protestants, but extending to all, and admitted by all, whether Protestants or Roman Catholics, Christians or Mahometans, Jews or Gentiles. And as it is of the greatest extent, so it is also of the highest importance. St. Paul expressly saith, that "if any provide not for his own, and especially for those of his own house, he hath denied the faith, and is worse than an infidel."*

In vain then do you endeavour to make men orthodox in points of faith, if at the same time, in the eyes of Christ and his apostles, you suffer them to be worse than infidels, than those who have no faith at all. There is something it seems worse than even infidelity; and to incite and stimulate you to put away that cursed thing from among you, is the design and aim of this address. The doctrine we recommend is an evident branch of the law of nature; it was taught by prophets, inculcated by apostles, encouraged and enforced by philosophers, legislators, and all wise states, in all ages, and in all parts of the world. Let me therefore intreat you to exert yourselves, to "be instant in season and out of season, rebuke, reprove, exhort." Take all opportunities to drive the lion out of the way; raise your voices, omit no occasion, public or private, of awakening your wretched countrymen from their sweet dream of sloth.

Many suspect your religion to be the cause of that notorious idleness which prevails so generally among the natives of this island, as if the Roman Catholic faith was inconsistent with an honest diligence in a man's calling. But whoever considers the great spirit of industry that reigns in Flanders and France, and even beyond the Alps, must acknowledge this to be a groundless suspicion. In Piedmont and Genoa, in the Milanese and the

* 1 Tim. v. 8.

Venetian state, and indeed throughout all Lombardy, how well is the soil cultivated, and what manufactures of silk, velvet, paper, and other commodities flourish? The king of Sardinia will suffer no idle hands in his territories, no beggar to live by the sweat of another's brow; it has even been made penal at Turin to relieve a strolling beggar. To which I might add, that the person whose authority will be of the greatest weight with you, even the pope himself, is at this day endeavouring to put new life into the trade and manufactures of his country.

Though I am in no secret of the court of Rome, yet I will venture to affirm, that neither pope, nor cardinals, will be pleased to hear, that those of their communion are distinguished above all others, by sloth, dirt, and beggary; or be displeased at your endeavouring to rescue them from the reproach of such an infamous distinction.

The case is as clear as the sun: what we urge is enforced by every motive that can work on a reasonable mind. The good of your country, your own private interest, the duty of your function, the cries and distresses of the poor do with one voice call for your assistance. And if it is on all hands allowed to be right and just, if agreeable both to reason and religion, if coincident with the views both of your temporal and spiritual superiors, it is to be hoped, this address may find a favourable reception, and that a zeal for disputed points, will not hinder your concurring to propagate so plain and useful a doctrine, wherein we are all agreed.

When a leak is to be stopped, or a fire extinguished, do not all hands co-operate without distinction of sect or party? Or if I am fallen into a ditch, shall I not suffer a man to help out, until I have first examined his creed? Or when I am sick shall I refuse the physic, because my physician doth, or doth not believe the pope's supremacy?

Fas est et ab hoste doceri. But in truth, I am no enemy to your persons, whatever I may think of your tenets. On the contrary I am your sincere well-wisher. I consider you as my countrymen, as fellow-subjects, as professing belief in the same Christ. And I do most sincerely wish, there was no other contest between us but—who shall most completely practise the precepts of him by whose name we are called, and whose disciples we all profess to be.

A LETTER

TO

THE ROMAN CATHOLICS OF THE DIOCESE OF CLOYNE.

PUBLISHED IN THE LATE REBELLION, A. D. 1745.

MY COUNTRYMEN AND FELLOW-SUBJECTS,

NOTWITHSTANDING the differences of our religious opinions, I should be sorry to be wanting in any instance of humanity or good neighbourhood to any of you. For which reason I find myself strongly inclined, at this critical juncture, to put you in mind, that you have been treated with a truly Christian lenity under the present government; that your persons have been protected, and your properties secured by equal laws, and that it would be highly imprudent, as well as ungrateful, to forfeit these advantages, by making yourselves tools to the ambition of foreign princes, who fancy it expedient to raise disturbances among us at present, but as soon as their own ends are served, will not fail to abandon you, as they have always done.

Is it not evident, that your true interest consists in lying still, and waiting the event, since Ireland must necessarily follow the fate of England; and that therefore prudence and policy prescribe quiet to the Roman Catholics of this kingdom, who, in case a change of hands should not succeed, after your attempting to bring it about, must then expect to be on a worse foot than ever?

But we will suppose it succeeds to your wish. What then? Would not this undermine even your own interests and fortune, which are often interwoven with those of your neighbours? Would not all those, who have debts or money, or other effects in the hands of Protestants, be fellow-sufferers with them? Would not all those who hold, under the acts of settlement, be as liable as Protestants themselves to be dispossessed by the old proprietors? Or, can even those who are styled proprietors, flatter themselves with hopes of possessing the estates which they claim, which, in all likelihood, would be given to favourites, (perhaps to foreigners), who are near the person, or who fought the battles of their master.

Under Protestant governments, those of your communion have formerly enjoyed a greater share of the lands of this kingdom, and more ample privileges. You bore your part in the magistracy and the legislature, and could complain of no hardships on the score of your religion. If these advantages have been since impaired or lost, was it not by the wrong measures yourselves took to enlarge them, in several successive attempts, each of which left you weaker, and in a worse condition than you were before. And this, notwithstanding the vaunted succours of France and Spain, whose vain efforts, in conjunction with yours, constantly recoiled on your own heads, even when your numbers and circumstances were far more considerable than they now are.

You all know these things to be true. I appeal to your own breasts. Dear bought experience hath taught you, and past times instruct the present. But perhaps you follow conscience rather than interest. Will any men amongst you pretend to plead conscience against being quiet, or against paying allegiance and peaceable submission to a Protestant prince, which the first Christians paid even to heathen, and which those of your communion, at this day, pay to Mahometan and to idolatrous princes in Turkey and China, and which you yourselves have so often professed to pay to our present gracious sovereign? Conscience is quite out of the case. And what man in his senses would engage in a dangerous course, to which neither interest doth invite, nor conscience oblige him?

I heartily wish, that this advice may be as well taken as it is meant, and that you may maturely consider your true interest, rather than rashly repeat the same errors which you have so often repented of. So recommending you to the merciful guidance of Almighty God, I subscribe myself,

Your real well-wisher,

GEORGE CLOYNE.

MAXIMS CONCERNING PATRIOTISM.

1 EVERY man by consulting his own heart, may easily know whether he is or is not a patriot. But it is not so easy for the by-standers.

2. Being loud and vehement either against a court, or for a court, is no proof of patriotism.

3 A man whose passion for money runs high, bids fair for being no patriot. And he likewise whose appetite is keen for power.

4. A native than a foreigner, a married man than a bachelor, a believer than an infidel, have a better chance for being patriots.

5. It is impossible an epicure should be a patriot.

6. It is impossible a man who cheats at cards, or cogs the dice, should be a patriot.

7. It is impossible a man who is false to his friends and neighbours should be true to the public.

8. Every knave is a thorough knave. And a thorough knave is a knave throughout.

9. A man who hath no sense of God or conscience; would you make such a one guardian to your child? if not, why guardian to the state?

10. A sot, a beast, benummed and stupified by excess, is good for nothing, much less to make a patriot of.

11. A fop or man of pleasure makes but a scurvy patriot.

12. A sullen, churlish man, who loves nobody, will hardly love his country.

13. The love of praise and esteem may do something: but to make a true patriot there must be an inward sense of duty and conscience.

14. Honesty (like other things) grows from its proper seed, good principles early laid in the mind.

15. To be a real patriot, a man must consider his countrymen as God's creatures, and himself as accountable for his acting towards them.

16. If *pro aris et focis* be the life of patriotism, he who hath no religion or no home makes a suspected patriot.

17. No man perjures himself for the sake of conscience.

18. There is an easy way of reconciling malcontents. *Sunt verba et voces quibus hunc lenire dolorem*, &c.

19. A good groom will rather stroke than strike.

20. He who saith there is no such thing as an honest man, you may be sure is himself a knave.

21. I have no opinion of your bumper patriots. Some eat, some drink, some quarrel for their country. MODERN PATRIOTISM!

22. Ibycus is a carking, griping, closefisted fellow. It is odds that Ibycus is not a patriot.

23. We are not to think every clamorous haranguer, or every splenetic repiner against a court, is therefore a patriot.

24. A patriot is one who heartily wisheth the public prosperity, and doth not only wish, but also study and endeavour to promote it.

25. Gamesters, fops, rakes, bullies, stock-jobbers: alas! what patriots?

26. Some writers have thought it impossible that men should be brought to laugh at public spirit. Yet this hath been done in the present age.

27. The patriot aims at his private good in the public. The knave makes the public subservient to his private interest. The former considers himself as part of a whole, the latter considers himself as the whole.

28. There is and ever will be a natural strife between court and country. The one will get as much, and the other give as little as it can. How must the patriot behave himself?

29. He gives the necessary. If he gives more it is with a view of gaining more to his country.

30. A patriot will never barter the public money for his private gain.

31. Moral evil is never to be committed, physical evil may be incurred, either to avoid a greater evil, or to procure a good.

32. Where the heart is right, there is true patriotism.

33. In your man of business, it is easier to meet with a good head than a good heart.

34. A patriot will admit there may be honest men, and that honest men may differ.

35. He that always blames or always praises is no patriot.

36. Were all sweet and sneaking courtiers, or were all sour malcontents; in either case the public would thrive but ill.

37. A patriot would hardly wish there was no contrast in the state.

38. Ferments of the worst kind succeed to perfect inaction.

39. A man rages, rails, and raves; I suspect his patriotism.

40. The fawning courtier and the surly 'squire, often mean the same thing, each his own interest.

41. A patriot will esteem no man for being of his party.

42. The factious man is apt to mistake himself for a patriot.

THE QUERIST:

CONTAINING

SEVERAL QUERIES,

PROPOSED TO THE CONSIDERATION OF THE PUBLIC.

ADVERTISEMENT

BY THE AUTHOR.

THE Querist was first printed in the year one thousand seven hundred and thirty-five, since which time the face of things is somewhat changed. In this edition some alterations have been made. The three parts are published in one; some few queries are added, and many omitted, particularly of those relating to the sketch or plan of a national bank; which it may be time enough to take again in hand, when the public shall seem disposed to make use of such an expedient. I had determined with myself never to prefix my name to the Querist, but in the last edition was overruled by a friend, who was remarkable for pursuing the public interest with as much diligence, as others do their own. I apprehend the same censure on this that I incurred upon another occasion, for meddling out of my profession. Though to feed the hungry and clothe the naked, by promoting an honest industry, will, perhaps, be deemed no improper employment for a clergyman, who still thinks himself a member of the commonwealth. As the sum of human happiness is supposed to consist in the goods of mind, body, and fortune, I would fain make my studies of some use to mankind, with regard to each of these three particulars, and hope it will not be thought faulty or indecent in any man, of what profession soever, to offer his mite towards improving the manners, health, and prosperity of his fellow-creatures.

THE QUERIST.

Qu. 1. WHETHER there ever was, is, or will be, an industrious nation poor, or an idle rich?

2. Whether a people can be called poor, where the common sort are well fed, clothed, and lodged?

3. Whether the drift and aim of every wise state should not be, to encourage industry in its members? And whether those, who employ neither heads nor hands for the common benefit, deserve not to be expelled like drones out of a well-governed state?

4. Whether the four elements, and man's labour therein, be not the true source of wealth?

5. Whether money be not only so far useful, as it stirreth up industry, enabling men mutually to participate the fruits of each other's labour?

6. Whether any other means, equally conducing to excite and circulate the industry of mankind, may not be as useful as money?

7. Whether the real end and aim of men be not power? And whether he who could have every thing else at his wish or will, would value money?

8. Whether the public aim in every well governed state be not, that each member, according to his just pretensions and industry, should have power?

9. Whether power be not referred to action; and whether action doth not follow appetite or will?

10. Whether fashion doth not create appetites; and whether the prevailing will of a nation is not the fashion?

11. Whether the current of industry and commerce be not determined by this prevailing will?

12. Whether it be not owing to custom, that the fashions are agreeable?

13. Whether it may not concern the wisdom of the legislature to interpose in the making of fashions; and not leave an affair of so great influence, to the management of women and fops, tailors, and vintners?

14. Whether reasonable fashions are a greater restraint on freedom than those which are unreasonable?

15. Whether a general good taste in a people would not

greatly conduce to their thriving? And whether an uneducated gentry be not the greatest of national evils?

16. Whether customs and fashions do not supply the place of reason in the vulgar of all ranks? Whether, therefore, it doth not very much import that they should be wisely framed?

17. Whether the imitating those neighbours in our fashions, to whom we bear no likeness in our circumstances, be not one cause of distress to this nation?

18. Whether frugal fashions in the upper rank, and comfortable living in the lower, be not the means to multiply inhabitants?

19. Whether the bulk of our Irish natives are not kept from thriving, by that cynical content in dirt and beggary, which they possess to a degree beyond any other people in Christendom?

20. Whether the creating of wants be not the likeliest way to produce industry in a people? And whether, if our peasants were accustomed to eat beef and wear shoes, they would not be more industrious?

21. Whether other things being given, as climate, soil, &c., the wealth be not proportioned to the industry, and this to the circulation of credit, be the credit circulated or transferred by what marks or tokens soever?

22. Whether, therefore, less money, swiftly circulating, be not, in effect, equivalent to more money slowly circulating? Or, whether, if the circulation be reciprocally as the quantity of coin, the nation can be a loser?

23. Whether money is to be considered as having an intrinsic value, or as being a commodity, a standard, a measure, or a pledge, as is variously suggested by writers? And whether the true idea of money, as such, be not altogether that of a ticket or counter?

24. Whether the value or price of things be not a compounded proportion, directly as the demand, and reciprocally as the plenty?

25. Whether the terms crown, livre, pound sterling, &c., are not to be considered as exponents or denominations of such proportion? And whether gold, silver, and paper, are not tickets or counters for reckoning, recording, and transferring thereof?

26. Whether the denominations being retained, although the bullion were gone, things might not nevertheless be rated, bought and sold, industry promoted, and a circulation of commerce maintained?

27. Whether an equal raising of all sorts of gold, silver, and copper coin, can have any effect in bringing money into the kingdom? And whether altering the proportions between the several sorts can have any other effect, but multiplying one kind and lessening another, without any increase of the sum total?

28. Whether arbitrary changing the denomination of coin be not a public cheat?

29 What makes a wealthy people? Whether mines of gold and silver are capable of doing this? And whether the negroes, amidst the gold sands of Africa, are not poor and destitute?

30. Whether there be any virtue in gold or silver, other than as they set people at work, or create industry?

31. Whether it be not the opinion or will of the people, exciting them to industry, that truly enricheth a nation? And whether this doth not principally depend on the means for counting, transferring, and preserving power, that is, property of all kinds?

32. Whether if there was no silver or gold in the kingdom, our trade might not nevertheless supply bills of exchange, sufficient to answer the demands of absentees in England, or elsewhere?

33. Whether current bank-notes may not be deemed money? And whether they are not actually the greater part of the money of this kingdom?

34. Provided the wheels move, whether it is not the same thing, as to the effect of the machine, be this done by the force of wind, or water, or animals?

35. Whether power to command the industry of others be not real wealth? And whether money be not, in truth, tickets or tokens for conveying and recording such power? And whether it be of great consequence what materials the tickets are made of?

36. Whether trade, either foreign or domestic, be in truth any more than this commerce of industry?

37. Whether to promote, transfer, and secure this commerce, and this property in human labour, or, in other words, this power, be not the sole means of enriching a people; and how far this may be done independently of gold and silver?

38. Whether it were not wrong to suppose land itself to be wealth? And whether the industry of the people is not first to be considered as that which constitutes wealth, which makes even land and silver to be wealth, neither of which would have any value but as means and motives to industry?

39. Whether in the wastes of America a man might not possess twenty miles square of land, and yet want his dinner, or a coat to his back?

40. Whether a fertile land, and the industry of its inhabitants, would not prove inexhaustible funds of real wealth, be the counters for conveying and recording thereof what you will, paper, gold, or silver?

41. Whether a single hint be sufficient to overcome a prejudice? And whether even obvious truths will not sometimes bear repeating?

42. Whether if human labour be the true source of wealth, it doth not follow that idleness should of all things be discouraged in a wise state?

43. Whether even gold, or silver, if they should lessen the industry of its inhabitants, would not be ruinous to a country? And whether Spain be not an instance of this?

44. Whether the opinion of men, and their industry consequent thereupon, be not the true wealth of Holland, and not the silver supposed to be deposited in the bank at Amsterdam?

45. Whether there is in truth any such treasure lying dead? And whether it be of great consequence to the public that it should be real, rather than notional?

46. Whether, in order to understand the true nature of wealth and commerce, it would not be right to consider a ship's crew cast upon a desert island, and by degrees forming themselves to business and civil life, while industry begot credit, and credit moved to industry?

47. Whether such men would not all set themselves to work? Whether they would not subsist by the mutual participation of each other's industry? Whether when one man had in his way procured more than he could consume, he would not exchange his superfluities to supply his wants? Whether this must not produce credit? Whether to facilitate these conveyances, to record and circulate this credit, they would not soon agree on certain tallies, tokens, tickets, or counters?

48. Whether reflection in the better sort might not soon remedy our evils? And whether our real defect be not a wrong way of thinking?

49. Whether it would not be an unhappy turn in our gentlemen, if they should take more thought to create an interest to themselves in this or that county, or borough, than to promote the real interest of their country?

50. Whether if a man builds a house he doth not in the first place provide a plan which governs his work? And shall the public act without an end, a view, a plan?

51. Whether by how much the less particular folk think for themselves, the public be not so much the more obliged to think for them?

52. Whether small gains be not the way to great profit? And if our tradesmen are beggars, whether they may not thank themselves for it?

53. Whether some way might not be found for making criminals useful in public works, instead of sending them either to America or to the other world?

54. Whether we may not, as well as other nations, contrive employment for them? And whether servitude, chains, and hard labour, for a term of years, would not be a more discouraging,

as well as a more adequate punishment for felons, than even death itself?

55. Whether there are not such things in Holland as bettering houses, for bringing young gentlemen to order? And whether such an institution would be useless among us?

56. Whether it be true that the poor in Holland have no resource but their own labour, and yet there are no beggars in their streets?

57. Whether he whose luxury consumeth foreign products, and whose industry produceth nothing domestic to exchange for them, is not so far forth injurious to his country?

58. Whether necessity is not to be hearkened to before convenience, and convenience before luxury?

59. Whether to provide plentifully for the poor be not feeding the root, the substance whereof will shoot upwards into the branches, and cause the top to flourish?

60. Whether there be any instance of a state wherein the people, living neatly and plentifully, did not aspire to wealth?

61. Whether nastiness and beggary do not, on the contrary, extinguish all such ambition, making men listless, hopeless, and slothful?

62. Whether a country inhabited by people well fed, clothed, and lodged, would not become every day more populous? And whether a numerous stock of people in such circumstances would not constitute a flourishing nation? And how far the product of our own country may suffice for the compassing of this end?

63. Whether a people, who had provided themselves with the necessaries of life in good plenty, would not soon extend their industry to new arts and new branches of commerce?

64. Whether those same manufactures which England imports from other countries, may not be admitted from Ireland? And if so, whether lace, carpets, and tapestry, three considerable articles of English importation, might not find encouragement in Ireland? And whether an academy for design might not greatly conduce to the perfecting those manufactures among us?

65. Whether France and Flanders could have drawn so much money from England, for figured silks, lace, and tapestry, if they had not had academies for designing?

66. Whether when a room was once prepared, and models in plaster of Paris, the annual expense of such an academy need stand the public in above two hundred pounds a year?

67. Whether our linen manufacture would not find the benefit of this institution? And whether there be any thing that makes us fall short of the Dutch, in damasks, diapers, and printed linen, but our ignorance in design?

68. Whether those, who may slight this affair as notional, have sufficiently considered the extensive use of the art of design,

and its influences in most trades and manufactures, wherein the forms of things are often more regarded than the materials?*

69. Whether there be any art sooner learned than that of making carpets? And whether our women, with little time and pains, may not make more beautiful carpets than those imported from Turkey? And whether this branch of the woollen-manufacture be not open to us?

70. Whether human industry can produce, from such cheap materials, a manufacture of so great value, by any other art, as by those of sculpture and painting?

71. Whether pictures and statues are not in fact so much treasure? And whether Rome and Florence would not be poor towns without them?

72. Whether they do not bring ready money, as well as jewels? Whether in Italy, debts are not paid, and children portioned with them, as with gold and silver?

73. Whether it would not be more prudent to strike out and exert ourselves in permitted branches of trade, than to fold our hands and repine, that we are not allowed the woollen?

74. Whether it be true, that two millions are yearly expended by England by foreign lace and linen?

75. Whether immense sums are not drawn yearly into the Northern countries, for supplying the British navy with hempen manufactures?

76. Whether there be any thing more profitable than hemp? And whether there should not be great premiums for encouraging our hempen trade? What advantages may not Great Britain make of a country where land and labour are so cheap?

77. Whether Ireland alone might not raise hemp sufficient for the British navy? And whether it would not be vain to expect this from the British colonies in America, where hands are so scarce, and labour so excessively dear?

78. Whether if our own people want will or capacity for such an attempt, it might not be worth while for some undertaking spirits in England to make settlements, and raise hemp in the counties of Clare and Limerick, than which, perhaps, there is not fitter land in the world for that purpose? And whether both nations would not find their advantage therein?

79. Whether if all the idle hands in this kingdom were employed on hemp and flax, we might not find sufficient vent for these manufactures?

80. How far it may be in our own power to better our affairs, without interfering with our neighbours?

81. Whether the prohibition of our woollen-trade, ought not naturally to put us on other methods which give no jealousy?

* Since the first publication of this query, the art of design seems to be more considered and countenanced among us.

82. Whether paper be not a valuable article of commerce? And whether it be not true, that one single bookseller in London yearly expended above four thousand pounds in that foreign commodity?

83. How it comes to pass that the Venetians and Genoese, who wear so much less linen, and so much worse than we do, should yet make very good paper, and in great quantity, while we make very little?

84. How long it will be before my countrymen find out, that it is worth while to spend a penny, in order to get a groat?

85. If all the land were tilled that is fit for tillage, and all that sown with hemp and flax that is fit for raising them, whether we should have much sheep-walk beyond what was sufficient to supply the necessities of the kingdom?

86. Whether other countries have not flourished without the woollen-trade?

87. Whether it be not a sure sign, or effect of a country's thriving, to see it well cultivated and full of inhabitants? And if so, whether a great quantity of sheep-walk be not ruinous to a country, rendering it waste, and thinly inhabited?

88. Whether the employing so much of our land under sheep, be not in fact an Irish blunder?

89. Whether our hankering after our woollen-trade be not the true and only reason which hath created a jealousy in England towards Ireland? And whether any thing can hurt us more than such jealousy?

90. Whether it be not the true interest of both nations to become one people? And whether either be sufficiently apprised of this?

91. Whether the upper part of this people are not truly English, by blood, language, religion, manners, inclination, and interest?

92. Whether we are not as much Englishmen, as the children of old Romans born in Britain, were still Romans?

93. Whether it be not our true interest, not to interfere with them; and, in every other case, whether it be not their true interest to befriend us?

94. Whether a mint in Ireland might not be of great convenience to the kingdom; and whether it could be attended with any possible inconvenience to Great Britain? And whether there were not mints in Naples and in Sicily, when those kingdoms were provinces to Spain, or the house of Austria?

95. Whether any thing can be more ridiculous, than for the North of Ireland to be jealous of a linen manufacture in the South?

96. Whether the county of Tipperary be not much better land than the county of Armagh: and yet whether the latter is not much better improved and inhabited than the former?

97. Whether every landlord in the kingdom doth not know the cause of this? And yet how few are the better for such their knowledge?

98. Whether large farms under few hands, or small ones under many, are likely to be made most of? And whether flax and tillage do not naturally multiply hands, and divide land into small holdings, and well-improved?

99. Whether, as our exports are lessened, we ought not to lessen our imports? And whether these will not be lessened as our demands, and these as our wants, and these as our customs or fashions? Of how great consequence therefore are fashions to the public?

100. Whether it would not be more reasonable to mend our state than to complain of it; and how far this may be in our own power?

101. What the nation gains by those who live in Ireland upon the produce of foreign countries?

102. How far the vanity of our ladies in dressing, and of our gentlemen in drinking, contributes to the general misery of the people?

103. Whether nations as wise and opulent as ours, have not made sumptuary laws; and what hinders us from doing the same?

104. Whether those who drink foreign liquors, and deck themselves and their families with foreign ornaments, are not so far forth to be reckoned absentees?

105. Whether as our trade is limited, we ought not to limit our expences; and whether this be not the natural and obvious remedy?

106. Whether the dirt, and famine, and nakedness of the bulk of our people, might not be remedied, even although we had no foreign trade? And whether this should not be our first care; and whether, if this were once provided for, the conveniences of the rich would not soon follow?

107. Whether comfortable living doth not produce wants, and wants industry, and industry wealth?

108. Whether there is not a great difference between Holland and Ireland? And whether foreign commerce, without which the one could not subsist, be so necessary for the other?

109. Might we not put a hand to the plough, or the spade, although we had no foreign commerce?

110. Whether the exigencies of nature are not to be answered by industry on our own soil? And how far the conveniences and comforts of life may be procured, by a domestic commerce between the several parts of this kingdom?

111. Whether the women may not sew, spin, weave, embroider, sufficiently for the embellishment of their persons, and even

enough to raise envy in each other, without being beholden to foreign countries?

112. Suppose the bulk of our inhabitants had shoes to their feet, clothes to their backs, and beef in their bellies? Might not such a state be eligible for the public, even though the 'squires were condemned to drink ale and cider?

113. Whether if drunkenness be a necessary evil, men may not as well drink the growth of their own country?

114. Whether a nation within itself might not have real wealth, sufficient to give its inhabitants power and distinction, without the help of gold and silver?

115. Whether, if the arts of sculpture and painting were encouraged among us, we might not furnish our houses in a much nobler manner with our own manufactures?

116. Whether we have not, or may not have, all the necessary materials for building at home?

117. Whether tiles and plaster may not supply the place of Norway fir for flooring and wainscot?

118. Whether plaster be not warmer, as well as more secure, than deal? And whether a modern fashionable house, lined with fir, daubed over with oil and paint, be not like a fire-ship, ready to be lighted up by all accidents?

119. Whether larger houses, better built and furnished, a greater train of servants, the difference with regard to equipage and table, between finer and coarser, more and less elegant, may not be sufficient to feed a reasonable share of vanity, or support all proper distinctions? And whether all these may not be procured by domestic industry out of the four elements, without ransacking the four quarters of the globe?

120. Whether any thing is a nobler ornament, in the eye of the world, than an Italian palace, that is, stone and mortar skilfully put together, and adorned with sculpture and painting; and whether this may not be compassed without foreign trade?

121. Whether an expense in gardens and plantations would not be an elegant distinction for the rich, a domestic magnificence, employing many hands within, and drawing nothing from abroad?

122. Whether the apology which is made for foreign luxury in England, to wit, that they could not carry on their trade without imports as well as exports, will hold in Ireland?

123. Whether one may not be allowed to conceive and suppose a society, or nation of human creatures, clad in woollen cloths and stuffs, eating good bread, beef and mutton, poultry and fish in great plenty, drinking ale, mead and cider, inhabiting decent houses built of brick and marble, taking their pleasure in fair parks and gardens, depending on no foreign imports either for food or raiment? And whether such people ought much to be pitied?

124. Whether Ireland be not as well qualified for such a state as any nation under the sun?

125. Whether in such a state the inhabitants may not contrive to pass the twenty-four hours with tolerable ease and cheerfulness? And whether any people upon earth can do more?

126. Whether they may not eat, drink, play, dress, visit, sleep in good beds, sit by good fires, build, plant, raise a name, make estates, and spend them?

127. Whether upon the whole, a domestic trade may not suffice in such a country as Ireland, to nourish and clothe its inhabitants, and provide them with the reasonable conveniences, and even comforts of life?

128. Whether a general habit of living well would not produce numbers and industry; and whether, considering the tendency of human kind, the consequence thereof would not be foreign trade and riches, how unnecessary soever?

129. Whether, nevertheless, it be a crime to inquire how far we may do without foreign trade, and what would follow on such a supposition?

130. Whether the number and welfare of the subjects be not the true strength of the crown?

131. Whether in all public institutions, there should not be an end proposed, which is to be the rule and limit of the means? Whether this end should not be the well-being of the whole? And whether, in order to this, the first step should not be to clothe and feed our people?

132. Whether there be upon earth any Christian, or civilized people, so beggarly, wretched, and destitute, as the common Irish?

133. Whether, nevertheless, there is any other people whose wants may be more easily supplied from home?

134. Whether, if there was a wall of brass a thousand cubits high, round this kingdom, our natives might not nevertheless live cleanly and comfortably, till the land and reap the fruits of it?

135. What should hinder us from exerting ourselves, using our hands and brains, doing something or other, man, woman, and child, like the other inhabitants of God's earth?

136. Be the restraining our trade well or ill advised in our neighbours, with respect to their own interest, yet whether it be not plainly ours to accommodate ourselves to it?

137. Whether it be not vain to think of persuading other people to see their interest, while we continue blind to our own?

138. Whether there be any other nation possessed of so much good land, and so many able hands to work it, which yet is beholden for bread to foreign countries?

139. Whether it be true, that we import corn to the value of two hundred thousand pounds in some years?*

* Things are now better in respect of this particular, and some others, than they were when the Querist was first published.

140. Whether we are not undone by fashions made for other people? And whether it be not madness in a poor nation to imitate a rich one?

141. Whether a woman of fashion ought not to be declared a public enemy?

142. Whether it be not certain, that from the single town of Cork were exported, in one year, no less than one hundred and seven thousand one hundred and sixty-one barrels of beef; seven thousand three hundred and seventy-nine barrels of pork; thirteen thousand four hundred and sixty-one casks, and eighty-five thousand seven hundred and twenty-seven firkins of butter? And what hands were employed in this manufacture?

143. Whether a foreigner could imagine, that one half of the people were starving, in a country which sent out such plenty of provisions?

144. Whether an Irish lady, set out with French silks, and Flanders lace, may not be said to consume more beef and butter than a hundred of our labouring peasants?

145. Whether nine tenths of our foreign trade be not carried on singly to support the article of vanity?

146. Whether it can be hoped, that private persons will not indulge this folly, unless restrained by the public?

147. How vanity is maintained in other countries? Whether in Hungary, for instance, a proud nobility are not subsisted with small imports from abroad?

148. Whether there be a prouder people upon earth than the noble Venetians, although they all wear plain black clothes?

149. Whether a people are to be pitied that will not sacrifice their little particular vanities to the public good? And yet, whether each part would not accept their own foible from this public sacrifice, the 'squire his bottle, the lady her lace?

150. Whether claret be not often drank rather for vanity than for health or pleasure?

151. Whether it be true, that men of nice palates have been imposed on, by elder wine for French claret, and by mead for palm sack?

152. Do not Englishmen abroad purchase beer and cider at ten times the price of wine?

153. How many gentlemen are there in England of a thousand pounds per annum, who never drink wine in their own houses? Whether the same may be said of any in Ireland who have even one hundred pounds per annum?

154. What reason have our neighbours in England for discouraging French wines, which may not hold with respect to us also?

155. How much of the necessary sustenance of our people is yearly exported for brandy?

156. Whether, if people must poison themselves, they had not better do it with their own growth?

157. If we imported neither claret from France, nor fir from Norway, what the nation would save by it?

158. When the root yieldeth insufficient nourishment, whether men do not top the tree to make the lower branches thrive?

159. Whether, if our ladies drank sage or balm tea out of Irish ware, it would be an insupportable national calamity?

160. Whether it be really true that such wine is best as most encourages drinking, i. e. that must be given in the largest dose to produce its effect? And whether this holds with regard to any other medicine?

161. Whether that trade should not be accounted most pernicious, wherein the balance is most against us? And whether this be not the trade with France?

162. Whether it be not even madness to encourage trade with a nation that takes nothing of our manufacture?

163. Whether Ireland can hope to thrive, if the major part of her patriots shall be found in the French interest?

164. Whether great plenty and variety of excellent wines are not to be had on the coasts of Italy and Sicily? And whether those countries would not take our commodities of linen, leather, butter, &c., in exchange for them?

165. Particularly, whether the *Vinum Mamertinum*, which grows on the mountains about Messina, a red, generous wine, highly esteemed (if we may credit Pliny) by the ancient Romans, would not come cheap, and please the palates of our islanders?

166. Why, if a bribe by the palate or the purse be in effect the same thing, they should not be alike infamous?

167. Whether the vanity and luxury of a few ought to stand in competition with the interest of a nation?

168. Whether national wants ought not to be the rule of trade? And whether the most pressing wants of the majority ought not to be first considered?

169. Whether it is possible the country should be well improved, while our beef is exported, and our labourers live upon potatoes?

170. If it be resolved that we cannot do without foreign trade, whether, at least, it may not be worth while to consider what branches thereof deserve to be entertained, and how far we may be able to carry it on under our present limitations?

171. What foreign imports may be necessary, for clothing and feeding the families of persons not worth above one hundred pounds a year? And how many wealthier there are in the kingdom, and what proportion they bear to the other inhabitants?

172. Whether trade be not then on a right foot, when foreign commodities are imported in exchange only for domestic superfluities?

173. Whether the quantities of beef, butter, wool and leather, exported from this island, can be reckoned the superfluities of a country, where there are so many natives naked and famished?

174. Whether it would not be wise so to order our trade, as to export manufactures rather than provisions, and of those such as employ most hands?

175. Whether she would not be a very vile matron, and justly thought either mad or foolish, that should give away the necessaries of life from her naked and famished children, in exchange for pearls to stick in her hair, and sweat meats to please her own palate?

176. Whether a nation might not be considered as a family?

177. Whether the remark made by a Venetian ambassador to Cardinal Richelieu—that "France needed nothing to be rich and easy, but to know how to spend what she dissipates"—may not be of use also to other people?

178. Whether hungry cattle will not leap over bounds? And whether most men are not hungry in a country where expensive fashions obtain?

179. Whether there should not be published yearly schedules of our trade, containing an account of the imports and exports of the foregoing year?

180. Whether other methods may not be found for supplying the funds, besides the custom on things imported?

181. Whether any art or manufacture be so difficult as the making of good laws?

182. Whether our peers and gentlemen are born legislators? Or, whether that faculty be acquired by study and reflection?

183. Whether to comprehend the real interest of a people, and the means to procure it, doth not imply some fund of knowledge, historical, moral, and political, with a faculty of reason improved by learning?

184. Whether every enemy to learning be not a Goth? And whether every such Goth among us be not an enemy to the country?

185. Whether, therefore, it would not be an omen of ill presage, a dreadful phenomenon in the land, if our great men should take it in their heads to deride learning and education?

186. Whether, on the contrary, it should not seem worth while to erect a mart of literature in this kingdom, under wiser regulations and better discipline than in any other part of Europe? And whether this would not be an infallible means of drawing men and money into the kingdom?

187. Whether the governed be not too numerous for the governing part of our college? And whether it might not be expedient to convert thirty natives' places into twenty fellowships?

188. Whether if we had two colleges, there might not spring

a useful emulation between them? And whether it might not be contrived, so to divide the fellows, scholars, and revenues between both, as that no member should be a loser thereby?

189. Whether ten thousand pounds, well laid out, might not build a decent college, fit to contain two hundred persons; and whether the purchase money of the chambers would not go a good way towards defraying the expense?

190. Where this college should be situated?

191. Whether, in imitation of the Jesuits at Paris, who admit Protestants to study in their colleges, it may not be right for us also to admit Roman Catholics into our college, without obliging them to attend chapel duties, or catechisms, or divinity lectures? And whether this might not keep money in the kingdom, and prevent the prejudices of a foreign education?

192. Whether it is possible a state should not thrive, whereof the lower part were industrious, and the upper wise?

193. Whether the collected wisdom of ages and nations be not found in books?

194. Whether Themistocles's art of making a little city, or a little people, become a great one, be learned any where so well as in the writings of the ancients?

195. Whether a wise state hath any interest nearer heart than the education of youth?

196. Whether the mind, like soil, doth not by disuse grow stiff; and whether reasoning and study be not like stirring and dividing the glebe?

197. Whether an early habit of reflection, although obtained by speculative sciences, may not have its use in practical affairs?

198. Whether even those parts of academical learning which are quite forgotten may not have improved and enriched the soil, like those vegetables which are raised, not for themselves, but ploughed in for a dressing of land?

199. Whether it was not an Irish professor who first opened the public schools at Oxford? Whether this island hath not been anciently famous for learning? And whether at this day it hath any better chance for being considerable?

200. Whether we may not with better grace sit down and complain when we have done all that lies in our power to help ourselves?

201. Whether the gentleman of estate hath a right to be idle; and whether he ought not to be the great promoter and director of industry among his tenants and neighbours?

202. Whether in the cantons of Switzerland all under thirty years of age are not excluded from their great councils?

203. Whether Homer's compendium of education,

Μύθων μεν ρητῆρ ἔμεναι, πρηκτῆρά τε ἔργων, Iliad ix.

would not be a good rule for modern educators of youth? And

whether half the learning and study of these kingdoms is not useless, for want of a proper delivery and pronunciation being taught in our schools and colleges?

204. Whether, in any order, a good building can be made of bad materials? Or whether any form of government can make a happy state out of bad individuals?

205. What was it that Solomon compared to a jewel of gold in a swine's snout?

206. Whether the public is more concerned in any thing than in the procreation of able citizens?

207. Whether to the multiplying of human kind, it would not much conduce, if marriages were made with good liking?

208. Whether, if women had no portions, we should then see so many unhappy and unfruitful marriages?

209. Whether the laws be not, according to Aristotle, a mind without appetite or passion; and, consequently, without respect of persons?

210. Suppose a rich man's son marries a poor man's daughter, suppose also that a poor man's daughter is deluded and debauched by the son of a rich man; which is most to be pitied?

211. Whether the punishment should be placed on the seduced or the seducer?

212. Whether a promise made before God and man, in the most solemn manner, ought to be violated?

213. Whether it was Plato's opinion that, "for the good of the community, rich should marry with rich?" De Leg. lib. 4.

214. Whether as seed equally scattered produceth a goodly harvest, even so an equal distribution of wealth doth not cause a nation to flourish?

215. Whence is it that Barbs and Arabs are so good horses? And whether in those countries they are not exactly nice in admitting none but males of a good kind to their mares?

216. What effects would the same care produce in families?

217. Whether the real foundation for wealth must not be laid in the numbers, the frugality, and the industry of the people? And whether all attempts to enrich a nation by other means, as raising the coin, stock-jobbing and such arts, are not vain?

218. Whether a door ought not to be shut against all other methods of growing rich, save only by industry and merit? And whether wealth got otherwise would not be ruinous to the public?

219. Whether the abuse of banks and paper-money is a just objection against the use thereof? And whether such abuse might not easily be prevented?

220. Whether national banks are not found useful in Venice, Holland, and Hamburgh? And whether it is not possible to contrive one that may be useful also in Ireland?

221. Whether the banks of Venice and Amsterdam are not in the hands of the public?

222. Whether it may not be worth while to inform ourselves in the nature of those banks? And what reason can be assigned, why Ireland should not reap the benefit of such public banks, as well as other countries?

223. Whether a bank of national credit, supported by public funds, and secured by parliament, be a chimera or impossible thing; and if not, what would follow from the supposal of such a bank?

224. Whether the currency of a credit so well secured, would not be of great advantage to our trade and manufactures?

225. Whether the notes of such public bank would not have a more general circulation than those of private banks, as being less subject to frauds and hazards?

226. Whether it be not agreed that paper hath, in many respects, the advantage above coin, as being of more dispatch in payments, more easily transferred, preserved, and recovered when lost?

227. Whether, besides these advantages, there be not an evident necessity for circulating credit by paper, from the defect of coin in this kingdom?

228. Whether it be rightly remarked by some, that, as banking brings no treasure into the kingdom like trade, private wealth must sink as the bank riseth? And whether, whatever causeth industry to flourish and circulate, may not be said to increase our treasure?

229. Whether the ruinous effects of Mississippi, South Sea, and such schemes, were not owing to an abuse of paper-money or credit, in making it a means for idleness and gaming, instead of a motive and help to industry?

230. Whether the rise of the bank of Amsterdam was not purely casual, for the security and dispatch of payments? And whether the good effects thereof, in supplying the place of coin, and promoting a ready circulation of industry and commerce, may not be a lesson to us, to do that by design, which others fell upon by chance?

231. Whether plenty of small cash be not absolutely necessary for keeping up a circulation among the people; that is, whether copper be not more necessary than gold?

232. Whether that which increaseth the stock of a nation be not a means of increasing its trade? And whether that which increaseth the current credit of a nation, may not be said to increase its stock?

233. Whether the credit of the public funds be not a mine of gold to England? And whether any step that should lessen this credit ought not to be dreaded?

234. Whether such credit be not the principal advantage that England hath over France? I may add, over every other country in Europe.

235. Whether by this the public is not become possessed of the wealth of foreigners as well as natives? And whether England be not in some sort the treasury of christendom?

236. Whether, as our current domestic credit grew, industry would not grow likewise; and if industry, our manufactures; and if these, our foreign credit?

237. Whether foreign demands may not be answered by our exports without drawing cash out of the kingdom?

238. Whether, as industry increased, our manufactures would not flourish; and as these flourished, whether better returns would not be made from estates to their landlords, both within and without the kingdom?

239. Whether the sure way to supply people with tools and materials, and to set them at work, be not a free circulation of money, whether silver or paper?

240. Whether in New England, all trade and business is not as much at a stand, upon a scarcity of paper money, as with us from the want of specie?

241. Whether it be certain, that the quantity of silver in the bank of Amsterdam, be greater now than at first; but whether it be not certain, that there is a greater circulation of industry and extent of trade, more people, ships, houses, and commodities of all sorts, more power by sea and land?

242. Whether money, lying dead in the bank of Amsterdam, would not be as useless as in the mine?

243. Whether our visible security in land could be doubted? And whether there be any thing like this in the bank of Amsterdam?

244. Whether it be just to apprehend danger from trusting a national bank with power to extend its credit, to circulate notes which it shall be felony to counterfeit, to receive goods on loans, to purchase lands, to sell also or alienate them, and to deal in bills of exchange; when these powers are no other than have been trusted for many years with the bank of England, although in truth but a private bank?

245. Whether the objection from monopolies and an overgrowth of power, which are made against private banks, can possibly hold against a national one?

246. Whether the evil effects, which of late years have attended paper-money and credit in Europe, did not spring from subscriptions, shares, dividends, and stock-jobbing.

247. Whether the great evils attending paper-money in the British plantations of America have not sprung from the overrating their lands, and issuing paper without discretion, and

from the legislators breaking their own rules in favour of themselves, thus sacrificing the public to their private benefit? And whether a little sense and honesty might not easily prevent all such inconveniences?

248. Whether the subject of free thinking in religion be not exhausted? And whether it be not high time for our free thinkers to turn their thoughts to the improvement of their country?

249. Whether it must not be ruinous for a nation to sit down to game, be it with silver or with paper?

250. Whether, therefore, the circulating paper, in the late ruinous schemes of France and England, was the true evil, and not rather the circulating thereof, without industry? And whether the bank of Amsterdam, where industry had been for so many years substituted and circulated by transfers on paper, doth not clearly decide this point?

251. Whether there are not to be seen in America fair towns, wherein the people are well lodged, fed, and clothed, without a beggar in their streets, although there be not one grain of gold or silver current among them?

252. Whether these people do not exercise all arts and trades, build ships and navigate them to all parts of the world, purchase lands, till and reap the fruits of them, buy and sell, educate and provide for their children? Whether they do not even indulge themselves in foreign vanities?

253. Whether, whatever inconveniencies those people may have incurred from not observing either rules or bounds in their paper-money, yet it be not certain that they are in a more flourishing condition, have larger and better built towns, more plenty, more industry, more arts and civility, and a more extensive commerce, than when they had gold and silver current among them?

254. Whether a view of the ruinous effects of absurd schemes and credit mismanaged, so as to produce gaming and madness instead of industry, can be any just objection against a national bank calculated purely to promote industry?

255. Whether a scheme for the welfare of this nation should not take in the whole inhabitants? And whether it be not a vain attempt to project the flourishing of our protestant gentry, exclusive of the bulk of the natives?

256. Whether an oath, testifying allegiance to the king and disclaiming the pope's authority in temporals, may not be justly required of the Roman catholics? And whether, in common prudence or policy, any priest should be tolerated who refuseth to take it?

257. Whether there is any such thing as a body of inhabitants in any Roman catholic country under the sun, that profess an absolute submission to the pope's orders in matters of an in-

different nature, or that in such points do not think it their duty to obey the civil government?

258. Whether, since the peace of Utrecht, mass was not celebrated, and the sacraments administered in divers dioceses of Sicily, notwithstanding the pope's interdict?

259. Whether a sum, which would go but a little way towards erecting hospitals for maintaining and educating the children of the native Irish, might not go far in binding them out apprentices to protestant masters, for husbandry, useful trades, and the service of families?

260. Whether there be any instance of a people's being converted in a Christian sense, otherwise than by preaching to them and instructing them in their own language?

261. Whether catechists in the Irish tongue may not easily be procured and subsisted? And whether this would not be the most practicable means for converting the natives?

262. Whether it be not of great advantage to the church of Rome that she hath clergy suited to all ranks of men, in gradual subordination, from cardinals down to mendicants?

263. Whether her numerous poor clergy are not very useful in missions, and of much influence with the people?

264. Whether, in defect of able missionaries, persons conversant in low life, and speaking the Irish tongue, if well instructed in the first principles of religion and in the popish controversy, though for the rest on a level with the parish clerks, or the schoolmasters of charity-schools, may not be fit to mix with, and bring over our poor illiterate natives to the established church? Whether it is not to be wished that some parts of our liturgy and homilies were publicly read in the Irish language? And whether, in these views, it may not be right to breed up some of the better sort of children in the charity-schools, and qualify them for missionaries, catechists, and readers?

265. Whether a 'squire, possessed of land to the value of a thousand pounds per annum, or a merchant worth twenty thousand pounds in cash, would have most power to do good or evil upon any emergency? And whether the suffering Roman catholics to purchase forfeited lands, would not be good policy as tending to unite their interest with that of the government?

266. Whether the sea-ports of Galway, Limerick, Cork, and Waterford, are not to be looked on as keys of this kingdom? And whether the merchants are not possessed of these keys; and who are the most numerous merchants in those cities?

267. Whether a merchant cannot more speedily raise a sum, more easily conceal or transfer his effects, and engage in any desperate design with more safety than a landed man, whose estate is a pledge for his behaviour?

268. Whether a wealthy merchant bears not great sway

among the populace of a trading city? And whether power be not ultimately lodged in the people?

269. Whether, as others have supposed an Atlantis or Utopia, we also may not suppose an hyperborean island inhabited by reasonable creatures?

270. Whether an indifferent person, who looks into all hands, may not be a better judge of the game than a party who sees only his own?

271. Whether there be any country in Christendom more capable of improvement than Ireland?

272. Whether we are not as far before other nations with respect to natural advantages, as we are behind them with respect to arts and industry?

273. Whether we do not live in a most fertile soil and temperate climate, and yet whether our people in general do not feel great want and misery?

274. Whether my countrymen are not readier at finding excuses than remedies?

275. Whether the wealth and prosperity of our country do not hang by a hair, the probity of one banker, the caution of another, and the lives of all?

276. Whether we have not been sufficiently admonished of this by some late events?

277. Whether a national bank would not at once secure our properties, put an end to usury, facilitate commerce, supply the want of coin, and produce ready payments in all parts of the kingdom?

278. Whether the use or nature of money, which all men so eagerly pursue, be yet sufficiently understood or considered by all?

279. What doth Aristotle mean by saying, Λῆρος εἶναι δοκεῖ τὸ νόμισμα, De Repub. lib. ix. 9.

280. Whether mankind are not governed by imitation rather than by reason?

281. Whether there be not a measure or limit within which gold and silver are useful, and beyond which they may be hurtful?

282. Whether that measure be not the circulating of industry?

283. Whether a discovery of the richest gold mine, that ever was in the heart of this kingdom, would be a real advantage to us?

284. Whether it would not tempt foreigners to prey upon us?

285. Whether it would not render us a lazy, proud, and dastardly people?

286. Whether every man who had money enough, would not be a gentleman? And whether a nation of gentlemen would not be a wretched nation?

287. Whether all things would not bear a high price? And

whether men would not increase their fortunes without being the better for it?

288. Whether the same evils would be apprehended from paper-money under an honest and thrifty regulation?

289. Whether, therefore, a national bank would not be more beneficial than even a mine of gold?

290. Whether without private banks what little business and industry there is would not stagnate? But whether it be not a mighty privilege for a private person, to be able to create an hundred pounds with a dash of his pen?

291. Whether the wise state of Venice was not the first that conceived the advantage of a national bank?

292. Whether the great exactness and integrity with which this bank is managed, be not the chief support of that republic?

293. Whether the bank of Amsterdam was not begun about one hundred and thirty years ago, and whether at this day, its stock be not conceived to amount to three thousand tons of gold, or thirty millions sterling?

294. Whether all payments of contracts for goods in gross and letters of exchange, must not be made by tranfers in the bank books, provided the sum exceed three hundred florins?

295. Whether it be not owing to this bank that the city of Amsterdam, without the least confusion, hazard, or trouble, maintains and every day promotes so general and quick a circulation of industry.

296. Whether it be not the greatest help and spur to commerce, that property can be so readily conveyed and so well secured by a *compte en banc*, that is, by only writing one man's name for another's in the bank-book?

297. Whether at the beginning of the last century, those who had lent money to the public during the war with Spain, were not satisfied by the sole expedient of placing their names in a *compte en banc*, with liberty to transfer their claims?

298. Whether the example of those easy transfers in the *compte en banc*, thus casually erected, did not tempt other men to become creditors to the public, in order to profit by the same secure and expeditious method of keeping and transferring their wealth?

299. Whether this *compte en banc* hath not proved better than a mine of gold to Amsterdam?

300. Whether that city may not be said to owe her greatness to the unpromising accident of her having been in debt more than she was able to pay?

301. Whether it be known that any state from such small beginnings, in so short a time, ever grew to so great wealth and power as the province of Holland hath done; and whether the

bank of Amsterdam hath not been the real cause of such extraordinary growth?

302. Whether the success of those public banks in Venice, Amsterdam, and Hamburgh, would not naturally produce in other states an inclination to the same methods?

303. Whether it be possible, for a national bank to subsist and maintain its credit under a French government?

304. Whether our natural appetites, as well as powers, are not limited to their respective ends and uses? But whether artificial appetites may not be infinite?

305. Whether the simple getting of money, or passing it from hand to hand without industry, be an object worthy of a wise government?

306. Whether, if money be considered as an end, the appetite thereof be not infinite? But whether the ends of money itself be not bounded?

307. Whether the total sum of all other powers, be it of enjoyment or action, which belong to man, or to all mankind together, is not in truth a very narrow and limited quantity? But whether fancy is not boundless?

308. Whether this capricious tyrant, which usurps the place of reason, doth not most cruelly torment and delude those poor men, the usurers, stock-jobbers, and projectors, of content to themselves from heaping up riches, that is, from gathering counters, from multiplying figures, from enlarging denominations, without knowing what they would be at, and without having a proper regard to the use, or end, or nature of things?

309. Whether the *ignis fatuus* of fancy doth not kindle immoderate desires, and lead men into endless pursuits and wild labyrinths?

310. Whether counters be not referred to other things, which so long as they keep pace and proportion with the counters, it must be owned the counters are useful, but whether beyond that to value or covet counters, be not direct folly?

311. Whether the public aim ought not to be that men's industry should supply their present wants, and the overplus be converted into a stock of power?

312. Whether the better this power is secured, and the more easily it is transferred, industry be not so much the more encouraged?

313. Whether money, more than is expedient for those purposes, be not upon the whole hurtful, rather than beneficial to a state?

314. Whether the promoting of industry should not be always in view, as the true and sole end, the rule and measure of a national bank? And whether all deviations from that object should not be carefully avoided?

315. Whether it may not be useful, for supplying manufactures and trade with stock, for regulating exchange, for quickening commerce, for putting spirit into the people?

316. Whether we are sufficiently sensible of the peculiar security there is in having a bank, that consists of land and paper, one of which cannot be exported, and the other is in no danger of being exported?

317. Whether it be not delightful to complain? And whether there be not many who had rather utter their complaints than redress their evils?

318. Whether, if "the crown of the wise be their riches,"* we are not the foolishest people in Christendom?

319. Whether we have not all the while great civil as well as natural advantages?

320. Whether there be any people who have more leisure to cultivate the arts of peace and study the public weal?

321. Whether other nations who enjoy any share of freedom, and have great objects in view, be not unavoidably embarrassed and distracted by factions? But whether we do not divide upon trifles, and whether our parties are not a burlesque upon politics?

322. Whether it be not an advantage that we are not embroiled in foreign affairs; that we hold not the balance of Europe; that we are protected by other fleets and armies; that it is the true interest of a powerful people, from whom we are descended, to guard us on all sides?

323. Whether England doth not really love us and wish well to us, as bone of her bone, and flesh of her flesh? And whether it be not our part to cultivate this love and affection all manner of ways?

324. What sea-ports or foreign trade have the Swiss? And yet how warm are those people, and how well provided!

325. Whether there may not be found a people who so contrive as to be impoverished by their trade? And whether we are not that people?

326. Whether it would not be better for this island, if all our fine folk of both sexes were shipped off, to remain in foreign countries, rather than that they should spend their estates at home in foreign luxury, and spread the contagion thereof through their native land?

327. Whether our gentry understand or have a notion of magnificence, and whether for want thereof they do not affect very wretched distinctions?

328. Whether there be not an art or skill in governing human pride, so as to render it subservient to the public aim?

329. Whether the great and general aim of the public should not be to employ the people?

* Prov. xiv. 24.

330. What right an eldest son hath to the worst education?

331. Whether men's counsels are not the result of their knowledge and their principles?

332. Whether there be not labour of the brains as well as of the hands, and whether the former is beneath a gentleman?

333. Whether the public be more interested to protect the property acquired by mere birth than that which is the immediate fruit of learning and virtue?

334. Whether it would not be a poor and ill-judged project to attempt to promote the good of the community, by invading the rights of one part thereof, or of one particular order of men?

335. Whether there be a more wretched, and at the same time a more unpitied case, than for men to make precedents for their own undoing?

336. Whether to determine about the rights and properties of men by other rules than the law be not dangerous?

337. Whether those men who move the corner-stones of a constitution may not pull an old house on their own heads?

338. Whether there be not two general methods whereby men become sharers in the national stock of wealth or power, industry and inheritance? And whether it would be wise in a civil society to lessen that share which is allotted to merit and industry?

339. Whether all ways of spending a fortune be of equal benefit to the public; and what sort of men are aptest to run into an improper expense?

340. If the revenues allotted for the encouragement of religion and learning were made hereditary in the hands of a dozen lay lords, and as many overgrown commoners, whether the public would be much the better for it?

341. Whether the church's patrimony belongs to one tribe alone; and whether every man's son, brother, or himself, may not, if he please, be qualified to share therein?

342. What is there in the clergy to create a jealousy in the public? Or what would the public lose by it, if every 'squire in the land wore a black coat, said his prayers, and was obliged to reside?

343. Whether there be any thing perfect under the sun? And whether it be not with the world as with a particular state, and with a state or body politic as with the human body, which lives and moves under various indispositions, perfect health being seldom or never to be found?

344. Whether, nevertheless, men should not in all things aim at perfection? And, therefore, whether any wise and good man would be against applying remedies? But whether it is not natural to wish for a benevolent physician?

345. Whether the public happiness be not proposed by the

legislature, and whether such happiness doth not contain that of the individuals?

346. Whether, therefore, a legislator should be content with a vulgar share of knowledge? Whether he should not be a person of reflection and thought, who hath made it his study to understand the true nature and interest of mankind, how to guide men's humours and passions, how to incite their active powers, how to make their several talents co-operate to the mutual benefit of each other, and the general good of the whole?

347. Whether it doth not follow, that above all things a gentleman's care should be to keep his own faculties sound and entire?

348. Whether the natural phlegm of this island needs any additional stupifier?

349. Whether all spirituous liquors are not, in truth, opiates?

350. Whether our men of business are not generally very grave by fifty?

351. Whether all men have not faculties of mind or body which may be employed for the public benefit?

352. Whether the main point be not to multiply and employ our people?

353. Whether hearty food and warm clothing would not enable and encourage the lower sort to labour?

354. Whether, in such a soil as ours, if there was industry, there could be want?

355. Whether the way to make men industrious be not to let them taste the fruits of their industry? And whether the labouring ox should be muzzled?

356. Whether our landlords are to be told, that industry and numbers would raise the value of their lands, or that one acre about the Tholsel is worth ten thousand acres in Connaught?

357. Whether our old native Irish are not the most indolent and supine people in Christendom?

358. Whether they are yet civilized, and whether their habitations and furniture are not more sordid than those of the savage Americans?

359. Whether it be not a sad circumstance to live among lazy beggars? And whether, on the other hand, it would not be delightful to live in a country swarming, like China, with busy people?

360. Whether we should not cast about, by all manner of means, to excite industry, and to remove whatever hinders it? And whether every one should not lend an helping hand?

361. Whether vanity itself should not be engaged in this good work? And whether it is not to be wished, that the finding of employment for themselves and others, were a fashionable distinction among the ladies?

362. Whether idleness be the mother or the daughter of spleen?

363. Whether it may not be worth while to publish the conversation of Ischomachus and his wife, in Xenophon, for the use of our ladies?

364. Whether it is true, that there have been, upon a time, one hundred millions of people employed in China, without the woollen-trade, or any foreign commerce?

365. Whether the natural inducements to sloth are not greater in the mogul's country than in Ireland, and yet whether in that suffocating and dispiriting climate, the Banyans are not all, men, women, and children, constantly employed?

366. Whether it be not true, that the great mogul's subjects might undersell us even in our own markets, and clothe our people with their stuffs and calicoes, if they were imported duty free?

367. Whether there can be a greater reproach on the leading men and the patriots of a country, than that the people should want employment? And whether methods may not be found to employ even the lame and the blind, the dumb, the deaf, and the maimed, in some or other branch of our manufactures?

368. Whether much may not be expected from a biennial consultation of so many wise men about the public good?

369. Whether a tax upon dirt would not be one way of encouraging industry?

370. Whether it would be a great hardship, if every parish were obliged to find work for their poor?

371. Whether children especially, should not be inured to labour betimes?

372. Whether there should not be erected, in each province, an hospital for orphans and foundlings at the expense of old bachelors?

373. Whether it be true, that in the Dutch workhouses, things are so managed, that a child four years old, may earn its own livelihood?

374. What a folly is it to build fine houses, or establish lucrative posts and large incomes, under the notion of providing for the poor?

375. Whether the poor grown up and in health need any other provision, but their own industry under public inspection?

376. Whether the poor-tax in England hath lessened or increased the number of the poor?

377. Whether workhouses should not be made at the least expense, with clay-floors and walls of rough stone, without plastering, ceiling, or glazing.

378. Whether it be an impossible attempt to set our people at work, or whether industry be a habit which like other habits, may by time and skill be introduced among any people?

379. Whether all manner of means should not be employed to possess the nation in general, with an aversion and contempt for idleness and all idle folk?

380. Whether it would be a hardship on people destitute of all things, if the public furnished them with necessaries which they should be obliged to earn by their labour?

381. Whether other nations have not found great benefit from the use of slaves in repairing high roads, making rivers navigable, draining bogs, erecting public buildings, bridges and manufactures?

382. Whether temporary servitude would not be the best cure for idleness and beggary?

383. Whether the public hath not a right to employ those who cannot, or who will not find employment for themselves?

384. Whether all sturdy beggars should not be seized and made slaves to the public for a certain term of years?

385. Whether he who is chained in a jail or dungeon hath not for the time lost his liberty? And if so, whether temporary slavery be not already admitted among us?

386. Whether a state of servitude, wherein he should be well worked, fed and clothed, would not be a preferment to such a fellow?

387. Whether criminals in the freest country may not forfeit their liberty, and repair the damage they have done the public by hard labour?

388. What the word servant signifies in the New Testament?

389. Whether the view of criminals chained in pairs and kept at hard labour, would not be very edifying to the multitude?

390. Whether the want of such an institution be not plainly seen in England, where the disbelief of a future state hardeneth rogues against the fear of death, and where, through the great growth of robbers and house-breakers it becomes every day more necessary?

391. Whether it be not easier to prevent than to remedy, and whether we should not profit by the example of others?

392. Whether felons are not often spared, and therefore encouraged, by the compassion of those who should prosecute them?

393. Whether many that would not take away the life of a thief, may not nevertheless be willing to bring him to a more adequate punishment?

394. Whether the most indolent would be fond of idleness, if they regarded it as the sure road to hard labour?

395. Whether the industry of the lower part of our people doth not much depend on the expense of the upper?

396. What would be the consequence, if our gentry affected to distinguish themselves by fine houses rather than fine clothes?

397. Whether any people in Europe are so meanly provided

with houses and furniture in proportion to their incomes, as the men of estates in Ireland?

398. Whether building would not peculiarly encourage all other arts in this kingdom?

399. Whether smiths, masons, bricklayers, plasterers, carpenters, joiners, tilers, plumbers, and glaziers, would not all find employment if the humour of building prevailed?

400. Whether the ornaments and furniture of a good house do not employ a number of all sorts of artificers, in iron, wood, marble, brass, pewter, copper, wool, flax, and divers other materials?

401. Whether in buildings and gardens, a great number of day-labourers do not find employment?

402. Whether by these means much of that sustenance and wealth of this nation which now goes to foreigners would not be kept at home, and nourish and circulate among our own people?

403. Whether as industry produced good living, the number of hands and mouths would not be increased; and in proportion thereunto, whether there would not be every day more occasion for agriculture? And whether this article alone would not employ a world of people?

404. Whether such management would not equally provide for the magnificence of the rich, and the necessities of the poor?

405. Whether an expense in building and improvements doth not remain at home, pass to the heir, and adorn the public? And whether any of these things can be said of claret?

406. Whether fools do not make fashions, and wise men follow them?

407. Whether, for one who hurts his fortune by improvements, twenty do not ruin themselves by foreign luxury?

408. Whether in proportion as Ireland was improved and beautified by fine seats, the number of absentees would not decrease?

409. Whether he who employs men in buildings and manufactures doth not put life in the country, and whether the neighbourhood round him be not observed to thrive?

410. Whether money circulated on the landlords own lands, and among his own tenants, doth not return into his own pocket?

411. Whether every 'squire that made his domain swarm with busy hands, like a bee-hive or ant-hill, would not serve his own interest, as well as that of his country?

412. Whether a gentleman, who hath seen a little of the world and observed how men live elsewhere, can contentedly sit down in a cold, damp, sordid habitation, in the midst of a bleak country, inhabited by thieves and beggars?

413. Whether on the other hand, a handsome seat amidst well-improved lands, fair villages, and a thriving neighbourhood,

may not invite a man to dwell on his own estate, and quit the life of an insignificant saunterer about town, for that of an useful country-gentleman?

414. Whether it would not be of use and ornament, if the towns throughout this kingdom were provided with decent churches, town-houses, workhouses, market-places and paved streets, with some order taken for cleanliness?

415. Whether if each of these towns were addicted to some peculiar manufacture, we should not find, that the employing many hands together on the same work was the way to perfect our workmen? And whether all these things might not soon be provided by a domestic industry, if money were not wanting?

416. Whether money could ever be wanting to the demands of industry, if we had a national bank?

417. Whether the fable of Hercules and the carter, ever suited any nation like this nation of Ireland?

418. Whether it be not a new spectacle under the sun, to behold in such a climate and such a soil, and under such a gentle government, so many roads untrodden, fields untilled, houses desolate and hands unemployed?

419. Whether there is any country in Christendom, either kingdom or republic, depending or independent, free or enslaved, which may not afford us an useful lesson?

420. Whether the frugal Swiss have any other commodities, but their butter and cheese and a few cattle, for exportation; whether, nevertheless, the single canton of Bearn hath not in her public treasury two millions sterling?

421. Whether that small town of Bearn, with its scanty, barren territory, in a mountainous corner, without sea-ports, without manufactures, without mines, be not rich by mere dint of frugality?

422. Whether the Swiss in general have not sumptuary laws, prohibiting the use of gold, jewels, silver, silk, and lace in their apparel, and indulging the women only to wear silk on festivals, weddings, and public solemnities?

423. Whether there be not two ways of growing rich, sparing and getting? But whether the lazy spendthrift must not be doubly poor?

424. Whether money circulating be not the life of industry; and whether the want thereof doth not render a state gouty and inactive?

425. But, whether if we had a national bank, and our present cash (small as it is) were put into the most convenient shape, men should hear any public complaints for want of money?

426. Whether all circulation be not alike a circulation of credit, whatsoever medium (metal or paper) is employed, and whether gold be any more than credit for so much power?

427. Whether the wealth of the richest nations in Christendom doth not consist in paper, vastly more than in gold and silver?

428. Whether lord Clarendon doth not aver of his own knowledge, that the prince of Orange, with the best credit, and the assistance of the richest men in Amsterdam, was above ten days endeavouring to raise twenty thousand pounds in specie, without being able to raise half the sum in all that time? See Clarendon's History, b. 12.

429. Supposing there had been hitherto no such thing as a bank, and the question were now first proposed, whether it would be safer to circulate unlimited bills in a private credit, or bills to a limited value on the public credit of the community, what would men think?

430. Whether the maxim, "What is everybody's business is nobody's," prevails in any country under the sun more than in Ireland?

431. Whether the united stock of a nation be not the best security? And whether anything but the ruin of the state can produce a national bankruptcy?

432. Whether the total sum of the public treasure, power and wisdom, all co-operating, be not most likely to establish a bank of credit, sufficient to answer the ends, relieve the wants, and satisfy the scruples of all people?

433. Whether London is not to be considered as the metropolis of Ireland? And whether our wealth (such as it is) doth not circulate through London, and throughout all England, as freely as that of any part of his majesty's dominions?

434. Whether, therefore, it be not evidently the interest of the people of England to encourage rather than to oppose a national bank in this kingdom, as well as every other means for advancing our wealth, which shall not impair their own?

435. Whether it is not our interest to be useful to them rather than rival them; and whether in that case we may not be sure of their good offices?

436. Whether we can propose to thrive, so long as we entertain a wrongheaded distrust of England?

437. Whether, as a national bank would increase our industry and that our wealth, England may not be a proportionable gainer; and whether we should not consider the gains of our mother-country as some accession to our own?

438. Whether there be any difficulty in comprehending that the whole wealth of the nation is in truth the stock of a national bank? And whether any more than the right comprehension of this be necessary to make all men easy with regard to its credit?

439. Whether the prejudices about gold and silver are not strong, but whether they are not still prejudices?

440. Whether paper doth not, by its stamp and signature, acquire a local value, and become as precious and as scarce as gold? And whether it be not much fitter to circulate large sums, and therefore preferable to gold?

441. Whether it doth not much import to have a right conception of money? And whether its true and just idea be not that of a ticket, entitling to power and fitted to record and transfer such power?

442. Though the bank of Amsterdam doth very rarely, if at all, pay out money, yet whether every man possessed of specie be not ready to convert it into paper, and act as cashier to the bank? And whether, from the same motive, every monied man throughout this kingdom would not be cashier to our national bank?

443. Whether we may not obtain that as friends, which it is in vain to hope for as rivals?

444. Whether in every instance by which we prejudice England, we do not, in a greater degree, prejudice ourselves?

445. Whether, in the rude original of society, the first step was not the exchanging of commodities, the next a substituting of metals by weight as the common medium of circulation, after this the making use of coin, lastly a further refinement by the use of paper with proper marks and signatures? And whether this, as it is the last, so it be not the greatest improvement?

446. Whether we are not in fact the only people who may be said to starve in the midst of plenty?

447. Whether there can be a worse sign than that people should quit their country for a livelihood? Though men often leave their country for health, or pleasure, or riches, yet to leave it merely for a livelihood? Whether this be not exceeding bad, and showeth some peculiar mismanagement?

448. Whether, in order to redress our evils, artificial helps are not most wanted in a land where industry is most against the natural grain of the people?

449. Whether, although the prepossessions about gold and silver have taken deep root, yet the example of our colonies in America doth not make it as plain as daylight, that they are not so necessary to the wealth of a nation as the vulgar of all ranks imagine?

450 Whether it be not evident that we may maintain a much greater inward and outward commerce, and be five times richer than we are; nay, and our bills abroad be of far greater credit, though we had not one ounce of gold or silver in the whole island?

451. Whether wrongheaded maxims, customs, and fashions, are not sufficient to destroy any people which hath so few resources as the inhabitants of Ireland?

452. Whether it would not be a horrible thing to see our matrons make dress and play their chief concern?

453. Whether our ladies might not as well endow monasteries as wear Flanders lace? And whether it be not true that popish nuns are maintained by protestant contributions?

454. Whether England, which hath a free trade, whatever she remits for foreign luxury with one hand, doth not with the other receive much more from abroad? Whether, nevertheless, this nation would not be a gainer, if our women would content themselves with the same moderation in point of expense as the English ladies?

455. But whether it be not a notorious truth, that our Irish ladies are on a foot, as to dress, with those of five times their fortune in England?

456. Whether it be not even certain, that the matrons of this forlorn country send out a greater proportion of its wealth for fine apparel, than any other females on the whole surface of this terraqueous globe?

457. Whether the expence, great as it is, be the greatest evil; but whether this folly may not produce many other follies, an entire derangement of domestic life, absurd manners, neglect of duties, bad mothers, a general corruption in both sexes?

458. Whether the first beginning of expedients do not always meet with prejudices? And whether even the prejudices of a people ought not to be respected?

459. Whether a national bank be not the true philosopher's stone in a state?

460. Whether all regulations of coin should not be made, with a view to encourage industry and a circulation of commerce, throughout the kingdom?

461. Whether to oil the wheel of commerce be not a common benefit? And whether this be not done by avoiding fractions and multiplying small silver?

462. Whether, all things considered, a general raising the value of gold and silver be not so far from bringing greater quantities thereof into the kingdom, that it would produce a direct contrary effect, inasmuch as less, in that case, would serve, and therefore less be wanted? And whether men do not import a commodity, in proportion to the demand or want of it?

463. Whether the lowering of our gold would not create a fever in the state? And whether a fever be not sometimes a cure, but whether it be not the last cure a man would choose?

464. Whether raising the value of a particular species will not tend to multiply such species, and to lessen others in proportion thereunto? And whether a much less quantity of cash in silver would not, in reality, enrich the nation more than a much greater in gold?

465. Whether, *cæteris paribus*, it be not true that the prices of things increase as the quantity of money increaseth, and are diminished as that is diminished? And whether, by the quantity of money, is not to be understood the amount of the denominations, all contracts being nominal for pounds, shillings, and pence, and not for weights of gold or silver?

466. Whether our exports do not consist of such necessaries as other countries cannot well be without?

467. Whether upon the circulation of a national bank more land would not be tilled, more hands employed, and consequently more commodities exported?

468. Whether silver and small money be not that which circulates the quickest, and passeth through all hands, on the road, in the market, at the shop?

469. Whether, all things considered, it would not be better for a kingdom that its cash consisted of half a million in small silver, than of five times that sum in gold?

470. Whether there be not every day five hundred lesser payments made for one that requires gold?

471. Whether Spain, where gold bears the highest value, be not the laziest; and China, where it bears the lowest, be not the most industrious country in the known world?

472. Whether it be not evidently the interest of every state, that its money should rather circulate than stagnate?

473. Whether the principal use of cash be not its ready passing from hand to hand to answer common occasions of the common people, and whether common occasions of all sorts of people are not small ones?

474. Whether business at fairs and markets is not often at a stand, and often hindered, even though the seller hath his commodities at hand and the purchaser his gold, yet for want of change?

475. As wealth is really power, and coin a ticket conveying power, whether those tickets which are the fittest for that use ought not to be preferred?

476. Whether those tickets which singly transfer small shares of power, and being multiplied large shares, are not fitter for common use than those which singly transfer large shares?

477. Whether the public is not more benefited by a shilling that circulates, than a pound that lies dead?

478. Whether sixpence twice paid, be not as good as a shilling once paid?

479. Whether the same shilling circulating in a village may not supply one man with bread, another with stockings, a third with a knife, a fourth with paper, a fifth with nails, and so answer many wants which must otherwise have remained unsatisfied?

480. Whether facilitating and quickening the circulation of power to supply wants, be not the promoting of wealth and industry among the lower people? And whether upon this the wealth of the great doth not depend?

481. Whether, without the proper means of circulation, it be not vain to hope for thriving manufactures and a busy people?

482. Whether four pounds in small cash may not circulate and enliven an Irish market, which many four pound pieces would permit to stagnate?*

483. Whether a man that could move nothing less than an hundred pound weight would not be much at a loss to supply his wants; and whether it would not be better for him to be less strong and more active?

484. Whether the natural body can be in a state of health and vigour, without a due circulation of the extremities, even in the fingers and toes? And whether the political body, any more than the natural, can thrive without a proportionable circulation through the minutest and most inconsiderable parts thereof?

485. If we had a mint for coining only shillings, sixpences, and copper money, whether the nation would not soon feel the good effects thereof?

486. Whether the greater waste by wearing of small coins would not be abundantly overbalanced by their usefulness?

487. Whether it be not the industry of common people that feeds the state, and whether it be possible to keep this industry alive without small money?

488. Whether the want of this be not a great bar to our employing the people in these manufactures which are open to us, and do not interfere with Great Britain?

489. Whether, therefore, such want doth not drive men into the lazy way of employing land under sheep walk?

490. Whether the running of wool from Ireland can so effectually be prevented, as by encouraging other business and manufactures among our people?

491. Whatever commodities Great Britain importeth, which we might supply, whether it be not her real interest to import them from us rather than from any other people?

492. Whether the apprehension of many among us (who for that very reason stick to their wool) that England may hereafter prohibit, limit, or discourage our linen trade, when it hath been once, with great pains and expense, thoroughly introduced and settled in this land, be not altogether groundless and unjust?

493. Whether it is possible for this country, which hath neither mines of gold nor a free trade, to support for any time the sending out of specie?

* In the year 1735, this country abounded with the large gold coins of Portugal, which being overrated, flowed in from all parts. But that evil is since remedied.

494. Whether, in fact, our payments are not made by bills? And whether our foreign credit doth not depend on our domestic industry, and our bills on that credit?

495. Whether, in order to mend it, we ought not first to know the peculiar wretchedness of our state? And whether there be any knowing of this but by comparison?

496. Whether there are not single market towns in England that turn more money in buying and selling than whole counties, perhaps provinces, with us?

497. Whether the small town of Birmingham alone doth not, upon an average, circulate every week one way or other, to the value of fifty thousand pounds? But whether the same crown may not be often paid?

498. Whether any kingdom in Europe be so good a customer at Bordeaux as Ireland?

499. Whether the police and economy of France be not governed by wise councils? And whether any one from this country, who sees their towns, and manufactures, and commerce, will not wonder what our senators have been doing?

500. What variety and number of excellent manufactures are to be met with throughout the whole kingdom of France?

501. Whether there are not every where some or other mills for many uses, forges and furnaces for iron-work, looms for tapestry, glass houses, and so forth?

502. What quantities of paper, stockings, hats, what manufactures of wool, silk, linen, hemp, leather, wax, earthernware, brass, lead, tin, &c.?

503. Whether the manufactures and commerce of the single town of Lyons do not amount to a greater value than all the manufactures and all the trade of this kingdom taken together?

504. Whether in the anniversary fair at the small town of Beaucair, upon the Rhone, there be not as much money laid out as the current cash of this kingdom amounts to?

505. Whether the very shreds shorn from woollen-cloth, which are thrown away in Ireland, do not make a beautiful tapestry in France?

506. Whether there be not French towns subsisted merely by making pins?

507. Whether the coarse fingers of those very women, those same peasants, who one part of the year till the ground and dress the vineyards, are not another employed in making the finest French point?

508. Whether there is not a great number of idle fingers among the wives and daughters of our peasants?

509. Whether the French do not raise a trade from saffron, dying drugs and the like products, which may do with us as well as with them?

510. Whether we may not have materials of our own growth to supply all manufactures, as well as France, except silk; and whether the bulk of what silk, even France manufactures, be not imported?

511. Whether it be possible for this country to grow rich, so long as what is made by domestic industry is spent in foreign luxury?

512. Whether our natural Irish are not partly Spaniards and partly Tartars; and whether they do not bear signatures of their descent from both these nations, which is also confirmed by all their histories?

513. Whether the Tartar progeny is not numerous in this land? And whether there is an idler occupation under the sun than to attend flocks and herds of cattle?

514. Whether the wisdom of the state should not wrestle with this hereditary disposition of our Tartars, and with a high hand introduce agriculture?

515. Whether once upon a time France did not, by her linen alone, draw yearly from Spain about eight millions of livres?

516. Whether the French have not suffered in their linen trade with Spain, by not making their cloth of due breadth; and whether any other people have suffered, and are still likely to suffer, through the same prevarication?*

517. Whether the Spaniards are not rich and lazy, and whether they have not a particular inclination and favour for the inhabitants of this island? But whether a punctual people do not love punctual dealers?

518. Whether about fourteen years ago we had not come into a considerable share of the linen trade with Spain; and what put a stop to this?

519. Whether if the linen manufacture were carried on in the other provinces, as well as in the north, the merchants of Cork, Limerick, and Galway, would not soon find the way to Spain?

520. Whether the woollen manufacture of England is not divided into several parts or branches, appropriated to particular places, where they are only or principally manufactured; fine cloths in Somersetshire, coarse in Yorkshire, long ells at Exeter, saies at Sudbury, crapes at Norwich, linseys at Kendal, blankets at Whitney, and so forth?

521. Whether the united skill, industry, and emulation of many together on the same work, be not the way to advance it? And whether it had been otherwise possible for England to have carried on her woollen-manufacture to so great perfection?

522. Whether it would not on many accounts be right, if we observed the same course with respect to our linen-manufacture;

* Things, we hear, are in a way of being mended with us in this respect.

and that diapers were made in one town or district, damasks in another, sheeting in a third, fine wearing linen in a fourth, coarse in a fifth, in another cambrics, in another thread and stockings, in others stamped linen, or striped linen, or tickings, or dyed linen, of which last kinds there is so great a consumption among the seafaring men of all nations?

523. Whether it may not be worth while to inform ourselves of the different sorts of linen which are in request among different people?

524. Whether we do not yearly consume of French wines about a thousand tun more than either Sweden or Denmark; and yet, whether those nations pay ready money as we do?

525. Whether it be not a custom for some thousands of Frenchmen to go about the beginning of March into Spain, and having tilled the lands and gathered the harvest of Spain, to return home with money in their pockets about the end of November?

526. Whether of late years our Irish labourers do not carry on the same business in England, to the great discontent of many there? But whether we have not much more reason than the people of England to be displeased at this commerce?

527. Whether, notwithstanding the cash supposed to be brought into it, any nation is, in truth, a gainer by such traffic?

528. Whether the industry of our people employed in foreign land, while our own is left uncultivated, be not a great loss to the country?

529. Whether it would not be much better for us, if, instead of sending our men abroad, we could draw men from the neighbouring countries to cultivate our own?

530. Whether, nevertheless, we are not apt to think the money imported by our labourers to be so much clear gains to this country; but whether a little reflection and a little political arithmetic, may not show us our mistake?

531. Whether our prejudices about gold and silver are not very apt to infect or misguide our judgments and reasonings about the public weal?

532. Whether it be not a good rule whereby to judge of the trade of any city, and its usefulness, to observe whether there is a circulation through the extremities, and whether the people round about are busy and warm?

533. Whether we had not, some years since, a manufacture of hats at Athlone, and of earthenware at Arklow; and what became of those manufactures?

534. Why do we not make tiles of our own, for flooring and roofing, rather than bring them from Holland?

535. What manufactures are there in France and Venice of gilt-leather, how cheap and how splendid a furniture?

536. Whether we may not for the same use, manufacture divers things at home, of more beauty and variety than wainscot, which is imported at such expense from Norway?

537. Whether the use and the fashion will not soon make a manufacture?

538. Whether if our gentry used to drink mead and cider, we should not soon have those liquors in the utmost perfection and plenty?

539. Whether it be not wonderful, that with such pastures, and so many black cattle, we do not find ourselves in cheese?

540. Whether great profits may not be made by fisheries; but whether those of our Irish who live by that business, do not contrive to be drunk and unemployed one half of the year?

541. Whether it be not folly to think, an inward commerce cannot enrich a state, because it doth not increase its quantity of gold and silver? And whether it is possible a country should not thrive, while wants are supplied, and business goes on?

542. Whether plenty of all the necessaries and comforts of life be not real wealth?

543. Whether Lyons, by the advantage of her midland situation and the rivers Rhone and Sone, be not a great magazine, or mart for inward commerce? And whether she doth not maintain a constant trade with most parts of France; with Provence for oils and dried fruits, for wines and Languedoc, for stuffs with Champaign, for linen with Picardy, Normandy, and Bretagne, for corn with Burgundy?

544. Whether she doth not receive and utter all those commodities, and raise a profit from the distribution thereof, as well as of her own manufactures, throughout the kingdom of France?

545. Whether the charge of making good roads and navigable rivers across the country, would not be really repaid by an inward commerce?

546. Whether as our trade and manufactures increased, magazines should not be established in proper places, fitted by their situation, near great roads and navigable rivers, lakes, or canals, for the ready reception and distribution of all sorts of commodities, from and to the several parts of the kingdom; and whether the town of Athlone, for instance, may not be fitly situated for such a magazine, or centre of domestic commerce?

547. Whether an inward trade would not cause industry to flourish, and multiply the circulation of our coin, and whether this may not do as well as multiplying the coin itself?

548. Whether the benefits of a domestic commerce are sufficiently understood and attended to, and whether the cause thereof be not the prejudiced and narrow way of thinking about gold and silver?

549. Whether there be any other more easy and unenvied method of increasing the wealth of a people?

550. Whether we of this island are not from our peculiar circumstances determined to this very commerce above any other, from the number of necessaries and good things that we possess within ourselves, from the extent and variety of our soil, from the navigable rivers and good roads which we have or may have at a less expense than any people in Europe, from our great plenty of materials for manufactures, and particularly from the restraints we lie under with regard to our foreign trade?

551. Whether annual inventories should not be published of the fairs throughout the kingdom, in order to judge of the growth of its commerce?

552. Whether there be not every year more cash circulated at the card-tables of Dublin, than at all the fairs of Ireland?

553. Whether the wealth of a country will not bear proportion to the skill and industry of its inhabitants?

554. Whether foreign imports that tend to promote industry should not be encouraged, and such as have a tendency to promote luxury should not be discouraged?

555. Whether the annual balance of trade between Italy and Lyons be not about four millions in favour of the former, and yet, whether Lyons be not a gainer by this trade?

556. Whether the general rule, of determining the profit of a commerce by its balance, doth not, like other general rules, admit of exceptions?

557. Whether it would not be a monstrous folly to import nothing but gold and silver, supposing we might do it, from every foreign part to which we trade? And yet, whether some men may not think this foolish circumstance a very happy one?

558. But whether we do not all see the ridicule of the mogul's subjects, who take from us nothing but our silver, and bury it under ground, in order to make sure thereof against the resurrection?

559. Whether he must not be a wrongheaded patriot or politician, whose ultimate view was drawing money into a country, and keeping it there?

560. Whether it be not evident, that not gold but industry causeth a country to flourish?

561. Whether it would not be a silly project in any nation, to hope to grow rich by prohibiting the exportation of gold and silver?

562. Whether there can be a greater mistake in politics, than to measure the wealth of the nation by its gold and silver?

563. Whether gold and silver be not a drug, where they do not promote industry? Whether they be not even the bane and undoing of an idle people?

564. Whether gold will not cause either industry or vice to flourish? And whether a country, where it flowed in without

labour, must not be wretched and dissolute like an island inhabited by buccaneers?

565. Whether arts and virtue are not likely to thrive, where money is made a means to industry? But whether money without this would be a blessing to any people?

566. Whether keeping cash at home, or sending it abroad, just as it most serves to promote industry, be not the real interest of every nation?

567. Whether commodities of all kinds do not naturally flow where there is the greatest demand? Whether the greatest demand for a thing be not where it is of most use? Whether money, like other things, hath not its proper use? Whether this use be not to circulate? Whether therefore there must not of course be money where there is a circulation of industry?

568. Whether it is not a great point to know what we would be at? And whether whole states, as well as private persons, do not often fluctuate for want of this knowledge?

569. Whether gold may not be compared to Sejanus's horse, if we consider its passage through the world, and the fate of those nations which have been successively possessed thereof?

570. Whether means are not so far useful as they answer the end? And whether, in different circumstances, the same ends are not obtained by different means?

571. If we are a poor nation, abounding with very poor people, will it not follow, that a far greater proportion of our stock should be in the smallest and lowest species, than would suit with England?

572. Whether, therefore, it would not be highly expedient, if our money were coined of peculiar values, best fitted to the circumstances and uses of our own country; and whether any other people could take umbrage at our consulting our own convenience in an affair entirely domestic, and that lies within ourselves?

573. Whether every man doth not know, and hath long known, that the want of a mint causeth many other wants in this kingdom?

574. What harm did England sustain about three centuries ago, when silver was coined in this kingdom?

575. What harm was it to Spain that her provinces of Naples and Sicily had all along mints of their own?

576. Whether it may not be presumed, that our not having a privilege, which every other kingdom in the world enjoys, be not owing to our own want of diligence and unanimity in soliciting for it?

577. Whether it be not the interest of England, that we should cultivate a domestic commerce among ourselves? And whether it could give them any possible jealousy, if our small sum of cash was contrived to go a little further, if there was a little more life in our markets, a little more buying and selling in our shops,

a little better provision for the backs and bellies of so many forlorn wretches throughout the towns and villages of this island?

578. Whether Great Britain ought not to promote the prosperity of her colonies, by all methods consistent with her own? And whether the colonies themselves ought to wish or aim at it by others?

579. Whether the remotest parts from the metropolis, and the lowest of the people, are not to be regarded as the extremities and capillaries of the political body?

580. Whether, although the capillary vessels are small, yet obstructions in them do not produce great chronical diseases?

581. Whether faculties are not enlarged and improved by exercise?

582. Whether the sum of the faculties put into act, or in other words, the united action of a whole people doth not constitute the momentum of a state?

583. Whether such momentum be not the real stock or wealth of a state; and whether its credit be not proportional thereunto?

584. Whether in every wise state the faculties of the mind are not most considered?

585. Whether the momentum of a state doth not imply the whole exertion of its faculties, intellectual and corporeal; and whether the latter without the former could act in concert?

586. Whether the divided force of men, acting singly, would not be a rope of sand?

587. Whether the particular motions of the members of a state, in opposite directions, will not destroy each other, and lessen the momentum of the whole; but whether they must not conspire to produce a great effect?

588. Whether the ready means to put spirit into this state, to fortify and increase its momentum, would not be a national bank and plenty of small cash?

589. Whether that which employs and exerts the force of a community, deserves not to be well considered and well understood?

590. Whether the immediate mover, the blood and spirits, be not money, paper or metal, and whether the soul or will of the community, which is the prime mover that governs and directs the whole, be not the legislature?

591. Supposing the inhabitants of a country quite sunk in sloth, or even fast asleep, whether upon the gradual awakening and exertion, first, of the sensitive and locomotive faculties, next of reason and reflection, then of justice and piety, the momentum of such country or state, would not, in proportion thereunto, become still more and more considerable?

592. Whether that which in the growth is last attained, and is the finishing perfection of a people, be not the first thing lost in their declension?

593. Whether force be not of consequence, as it is exerted; and whether great force without great wisdom may not be a nuisance?

594. Whether the force of a child applied with art, may not produce greater effects than that of a giant? And whether a small stock in the hands of a wise state, may not go further, and produce more considerable effects, than immense sums in the hands of a foolish one?

595. Whose fault is it if poor Ireland still continues poor?

A PROPOSAL

FOR THE BETTER SUPPLYING OF

CHURCHES IN OUR FOREIGN PLANTATIONS,

AND FOR

CONVERTING THE SAVAGE AMERICANS TO CHRISTIANITY,

BY A COLLEGE TO BE ERECTED ON THE SUMMER ISLANDS, OTHERWISE CALLED THE ISLES OF BERMUDA.

ALTHOUGH there are several excellent persons of the Church of England, whose good intentions and endeavours have not been wanting to propagate the gospel in foreign parts, who have even combined into societies for that very purpose, and given great encouragement, not only for English missionaries in the West Indies, but also, for the reformed of other nations, led by their example, to propagate Christianity in the east: it is nevertheless acknowledged, that there is at this day, but little sense of religion, and a most notorious corruption of manners in the English colonies settled on the continent of America, and the islands. It is also acknowledged, that the gospel hath hitherto made but a very inconsiderable progress among the neighbouring Americans, who still continue in much the same ignorance and barbarism, in which we found them above a hundred years ago.

I shall therefore venture to submit my thoughts upon a point, that I have long considered, to better judgments, in hopes that any expedient will be favourably hearkened to, which is proposed for the remedy of these evils. Now, in order to effect this, it should seem the natural proper method to provide, in the first place, a constant supply of worthy clergymen for the English churches in those parts; and in the second place, a like constant supply of zealous missionaries, well fitted for propagating Christianity among the savages.

For though the surest means to reform the morals, and soften the behaviour of men, be, to preach to them the pure uncorrupt doctrine of the gospel, yet it cannot be denied, that the success of preaching dependeth in good measure on the character and

skill of the preacher: forasmuch as mankind are more apt to copy characters than to practise precepts, and forasmuch as argument, to attain its full strength, doth not less require the life of zeal than the weight of reason; and the same doctrine, which maketh great impression, when delivered with decency and address, loseth very much of its force by passing through awkward or unskilful hands.

Now the clergy sent over to America have proved, too many of them, very meanly qualified both in learning and morals for the discharge of their office. And indeed little can be expected from the example or instruction of those, who quit their native country on no other motive, than that they are not able to procure a livelihood in it, which is known to be often the case.

To this may be imputed the small care that hath been taken to convert the negroes of our plantations, who to the infamy of England and scandal of the world, continue heathen under Christian masters, and in Christian countries. Which could never be if our planters were rightly instructed and made sensible, that they disappointed their own baptism by denying it to those who belong to them: that it would be of advantage to their affairs to have slaves who should "obey in all things their masters according to the flesh, not with eye-service as men-pleasers, but in singleness of heart as fearing God:" that gospel liberty consists with temporal servitude; and that their slaves would only become better slaves by being Christian.

And though it be allowed that some of the clergy in our colonies have approved themselves men of merit, it will at the same time be allowed, that the most zealous and able missionary from England must find himself but ill qualified for converting the American heathen, if we consider the difference of language, their wild way of living, and above all, the great jealousy and prejudice which savage nations have towards foreigners, or innovations introduced by them.

These considerations make it evident, that a college or seminary in those parts is very much wanted; and therefore the providing such a seminary is earnestly proposed and recommended to all those, who have it in their power, to contribute to so good a work. By this, two ends would be obtained.

First, the youth of our English plantations might be themselves fitted for the ministry; and men of merit would be then glad to fill the churches of their native country, which are now a drain for the very dregs and refuse of ours.

At present there are, I am told, many churches vacant in our plantations, and many very ill supplied; nor can all the vigilance and wisdom of that great prelate, whose peculiar care it is, prevent this, so long as the aforesaid churches are supplied from England.

And supplied they must be, with such as can be picked up in England or Ireland, until a nursery of learning for the education of the natives is founded. This indeed might provide a constant succession of learned and exemplary pastors; and what effect this must be supposed to have on their flocks, I need not say.

Secondly, the children of savage Americans, brought up in such a seminary, and well instructed in religion and learning, might make the ablest and properest missionaries for spreading the gospel among their countrymen; who would be less apt to suspect, and readier to embrace a doctrine recommended by neighbours or relations, men of their own blood and language, than if it were proposed by foreigners, who would not improbably be thought to have designs on the liberty or property of their converts.

The young Americans necessary for this purpose may in the beginning be procured, either by peaceable methods from those savage nations which border on our colonies and are in friendship with us, or by taking captive the children of our enemies.

It is proposed to admit into the aforesaid college only such savages as are under ten years of age, before evil habits have taken a deep root; and yet not so early as to prevent retaining their mother tongue, which should be preserved by intercourse among themselves.

It is further proposed to ground these young Americans thoroughly in religion and morality, and to give them a good tincture of other learning; particularly of eloquence, history, and practical mathematics; to which it may not be improper to add some skill in physic.

If there were a yearly supply of ten or a dozen such missionaries sent abroad into their respective countries, after they had received the degree of master of arts in the aforesaid college, and holy orders in England, (till such time as episcopacy be established in those parts) it is hardly to be doubted, but in a little time the world would see good and great effects thereof.

For, to any considering man, the employing American missionaries for the conversion of America, will, of all others, appear the most likely method to succeed; especially if care be taken that, during the whole course of their education, an eye should be had to their mission; that they should be taught betimes to consider themselves as trained up in that sole view, without any other prospect of provision or employment; that a zeal for religion and love of their country should be early and constantly instilled into their minds by repeated lectures and admonitions; that they should not only be incited by the common topics of religion and nature, but further animated and inflamed by the great examples in past ages, of public spirit and

virtue, to rescue their countrymen from their savage manners to a life of civility and religion.

If his majesty would graciously please to grant a charter for a college to be erected in a proper place for these uses, it is to be hoped that a fund may be soon raised, by the contribution of well-disposed persons, sufficient for building and endowing the same. For as the necessary expense would be small, so there are men of religion and humanity in England who would be pleased to see any design set forward for the glory of God and the good of mankind.

A small expense would suffice to subsist and educate the American missionaries in a plain simple manner, such as might make it easy for them to return to the coarse and poor methods of life in use among their countrymen; and nothing can contribute more to lessen this expense, than a judicious choice of the situation, where the seminary is to stand.

Many things ought to be considered in the choice of a situation. It should be in a good air; in a place where provisions are cheap and plenty; where an intercourse might easily be kept up with all parts of America and the islands; in a place of security, not exposed to the insults of pirates, savages, or other enemies; where there is no great trade which might tempt the readers or fellows of the college to become merchants, to the neglect of their proper business; where there are neither riches nor luxury to divert, or lessen their application, or to make them uneasy and dissatisfied with a homely frugal subsistence; lastly, where the inhabitants, if such a place may be found, are noted for innocence and simplicity of manners. I need not say of how great importance this point would be toward forming the morals of young students, and what mighty influence it must have on the mission.

It is evident the college, long since projected in Barbadoes, would be defective in many of these particulars; for though it may have its use among the inhabitants, yet a place of so high trade, so much wealth and luxury, and such dissolute morals (not to mention the great price and scarcity of provisions), must at first sight seem a very improper situation for a general seminary intended for the forming missionaries, and educating youth in religion and sobriety of manners. The same objections lie against the neighbouring islands.

And if we consider the accounts given of their avarice and licentiousness, their coldness in the practice of religion, and their aversion from propagating it (which appears in the withholding their slaves from baptism), it is to be feared that the inhabitants in the populous parts of our plantations on the continent are not much fitter than those in the islands above mentioned, to influence or assist such a design. And as to the more remote and

less frequented parts, the difficulty of being supplied with necessaries, the danger of being exposed to the inroads of savages, and above all, the want of intercourse with other places, render them improper situations for a seminary of religion and learning.

It will not be amiss to insert here an observation I remember to have seen in an abstract of the proceedings, &c., annexed to the dean of Canterbury's sermon, before the society for the propagation of the gospel in foreign parts; that the savage Indians, who live on the continent, will not suffer their children to learn English or Dutch, lest they should be debauched by conversing with their European neighbours; which is a melancholy but strong confirmation of the truth of what hath been now advanced.

A general intercourse and correspondence with all the English colonies, both on the islands and on the continent, and with other parts of America, hath been before laid down, as a necessary circumstance, the reason whereof is very evident. But this circumstance is hardly to be found. For on the continent, where there are neither inns, nor carriages, nor bridges over the rivers, there is no travelling by land between distant places. And the English settlements are reputed to extend along the sea-coast for the space of fifteen hundred miles. It is therefore plain there can be no convenient communication between them otherwise than by sea; no advantage, therefore, in this point, can be gained by settling on the continent.

There is another consideration which equally regards the continent and islands, that the general course of trade and correspondence lies from all those colonies to Great Britain alone: whereas, for our present purpose, it would be necessary to pitch upon a place, if such could be found, which maintains a constant intercourse with all the other colonies, and whose commerce lies chiefly or altogether (not in Europe, but) in America.

There is but one spot that I can find, to which this circumstance agrees; and that is the isles of Bermuda, otherwise called the Summer Islands. These having no rich commodity or manufacture, such as sugar, tobacco, or the like, wherewithal to trade to England, are obliged to become carriers for America, as the Dutch are for Europe. The Bermudans are excellent shipwrights and sailors, and have a great number of very good sloops, which are always passing and repassing from all parts of America. They drive a constant trade to the islands of Jamaica, Barbadoes, Antego, &c., with butter, onions, cabbages, and other roots and vegetables, which they have in great plenty and perfection. They have also some small manufactures of joiner's work and matting, which they export to the plantations on the continent. Hence Bermudan sloops are oftener seen in the ports of America than any other. And indeed, by the best information I could get, it

appears they are the only people of all the British plantations who hold a general correspondence with the rest.

And as the commerce of Bermudá renders it a very fit place wherein to erect a seminary, so likewise doth its situation, it being placed between our plantation on the continent and those in the isles, so as equally to respect both. To which may be added, that it lies in the way of vessels passing from America to Great Britain; all which makes it plain that the youth to be educated in a seminary placed in the Summer Islands, would have frequent opportunities of going thither and corresponding with their friends. It must indeed be owned, that some will be obliged to go a long way to any one place, which we suppose resorted to, from all parts of our plantations; but if we were to look out a spot the nearest approaching to an equal distance from all the rest, I believe it would be found to be Bermuda. It remains, that we see whether it enjoys the other qualities or conditions laid down as well as this.

The Summer Islands are situated near the latitude of thirty three degrees; no part of the world enjoys a purer air, or a more temperate climate, the great ocean which environs them at once moderating the heat of the south winds and the severity of the north-winds. Such a latitude on the continent might be thought too hot; but the air in Bermuda is perpetually fanned and kept cool by sea-breezes, which render the weather the most healthy and delightful that could be wished, being (as is affirmed by persons who have long lived there) of one equal tenor almost throughout the whole year, like the latter end of a fine May; insomuch that it is resorted to as the Montpelier of America.

Nor are these isles (if we may believe the accounts given of them) less remarkable for plenty than for health; there being, besides beef, mutton, and fowl, great abundance of fruits, and garden-stuff of all kinds in perfection: to this, if we add the great plenty and variety of fish which is every day taken on their coasts, it would seem that a seminary could nowhere be supplied with better provisions, or cheaper than here.

About forty years ago, upon cutting down many tall cedars that sheltered their orange-trees from the north-west wind (which sometimes blows even there so as to affect that delicate plant) great part of their orange plantations suffered; but other cedars are since grown up, and no doubt a little industry would again produce as great plenty of oranges as ever was there heretofore. I mention this, because some have inferred from the present scarcity of that fruit, for which Bermuda was once so famous, that there hath been a change in the soil and climate for the worse. But this, as hath been observed, proceeded from another cause, which is now in great measure taken away.

Bermuda is a cluster of small islands, which lie in a very

narrow compass, containing in all not quite twenty thousand acres. This group of isles is (to use Mr. Waller's expression) walled round with rocks, which render them inaccessible to pirates or enemies; there being but two narrow entrances, both well guarded by forts. It would therefore be impossible to find any where a more secure retreat for students.

The trade of Bermuda consists only in garden-stuff and some poor manufactures, principally of cedar and the palmetto-leaf. Bermuda hats are worn by our ladies: they are made of a sort of mat or (as they call it) platting made of the palmetto-leaf, which is the only commodity that I can find exported from Bermuda to Great Britain; and there is no prospect of making a fortune by this small trade, so it cannot be supposed to tempt the fellows of the college to engage in it, to the neglect of their peculiar business, which might possibly be the case elsewhere.

Such as their trade is, such is their wealth; the inhabitants being much poorer than the other colonies, who do not fail to despise them upon that account. But if they have less wealth, they have withal less vice and expensive folly than their neighbours. They are represented as a contented, plain, innocent sort of people, free from avarice and luxury, as well as the other corruptions that attend those vices.

I am also informed that they are more constant attendants on divine service, more kind and respectful to their pastor (when they have one), and show much more humanity to their slaves, and charity to one another, than is observed among the English in the other plantations; one reason of this may be, that condemned criminals, being employed in the manufactures of sugar and tobacco, were never transported thither. But, whatever be the cause, the facts are attested by a clergyman of good credit, who lived long among them.

Among a people of this character, and in a situation thus circumstantiated, it would seem that a seminary of religion and learning might very fitly be placed. The correspondence with other parts of America, the goodness of the air, the plenty and security of the place, the frugality and innocence of the inhabitants, all conspiring to favour such a design. Thus much at least is evident, that young students would be there less liable to be corrupted in their morals; and the governing part would be easier, and better contented with a small stipend, and a retired academical life, in a corner from whence avarice and luxury are excluded, than they can be supposed to be in the midst of a full trade and great riches, attended with all that high living and parade which our planters affect, and which, as well as all fashionable vices, should be far removed from the eyes of the young American missionaries, who are to lead a life of poverty and self-denial among their countrymen.

After all, it must be acknowledged, that though every thing else should concur with our wishes, yet if a set of good governors and teachers be wanting, who are acquainted with the methods of education, and have the zeal and ability requisite for carrying on a design of this nature, it would certainly come to nothing.

An institution of this kind should be set on foot by men of prudence, spirit, and zeal, as well as competent learning, who should be led to it by other motives than the necessity of picking up a maintenance. For upon this view, what man of merit can be supposed to quit his native country, and take up with a poor college subsistence in another part of the world, where there are so many considerable parishes actually void, and so many others ill supplied for want of fitting incumbents? Is it likely, that fellowships of fifty or sixty pounds a year should tempt abler or worthier men, than benefices of many times their value?

And except able and worthy men do first engage in this affair, with a resolution to exert themselves in forming the manners of the youth, and giving them a proper education, it is evident the mission and the college will be but in a very bad way. This inconvenience seems the most difficult to provide against, and if not provided against, it will be the most likely to obstruct any design of this nature. So true it is, that where ignorance or ill manners once take place in a seminary, they are sure to be handed down in a succession of illiterate or worthless men.

But this apprehension, which seems so well grounded, that a college in any part of America would either lie unprovided, or be worse provided than their churches are, hath no place in Bermuda; there being at this time several gentlemen, in all respects very well qualified, and in possession of good preferments, and fair prospects at home, who having seriously considered the great benefit that may arise to the church and to mankind from such an undertaking, are ready to engage in it, and to dedicate the remainder of their lives to the instructing the youth of America, and prosecuting their own studies upon a very moderate subsistence in a retirement, so sweet and so secure, and every way so well fitted for a place of education and study, as Bermuda.

Thus much the writer hereof thought himself obliged to say of his associates: for himself, he can only say, that as he values no preferment upon earth, so much as that of being employed in the execution of this design, so he hopes to make up for other defects by the sincerity of his endeavours.

In Europe, the protestant religion hath of late years considerably lost ground, and America seems the likeliest place, wherein to make up for what hath been lost in Europe, provided the proper methods are taken: otherwise the Spanish missionaries in the south, and the French in the north, are making such a

progress, as may one day spread the religion of Rome, and with it the usual hatred to protestants, throughout all the savage nations in America; which would probably end in the utter extirpation of our colonies, on the safety whereof depends so much of the nation's wealth, and so considerable a branch of his majesty's revenue.

But if this scheme were pursued, it would in all probability have much greater influence on the Americans, than the utmost endeavours of popish emissaries can possibly have; who from the difference of country, language, and interest, must lie under far greater difficulties and discouragements than those, whom we suppose yearly sent out from Bermuda to preach among their countrymen.

It cannot indeed be denied, that the great number of poor regulars, inured to hard living, and brought up in an implicit obedience to their superiors, hath hitherto given the church of Rome, in regard to her missions, great advantage over the reformed churches. But from what hath been said, it is, I think, evident, that this advantage may be over-balanced by our employing American missionaries.

Nor is the honour of the crown, nation, and church of England, unconcerned in this scheme; which, it is to be hoped, will remove the reproach, we have so long lain under, that we fall as far short of our neighbours of the Romish communion in zeal for propagating religion, as we surpass them in the soundness and purity of it. And at the same time, that the doing what may be so easily done, takes away our reproach; it will cast no small lustre on his majesty's reign, and derive a blessing from heaven on his administration, and those who live under the influence thereof.

Men of narrow minds have a peculiar talent at objection, being never at a loss for something to say against whatsoever is not of their own proposing. And perhaps it will be said in opposition to this proposal, that if we thought ourselves capable of gaining converts to the church, we ought to begin with infidels, papists, and dissenters of all denominations at home, and to make proselytes of these before we think of foreigners; and that therefore our scheme is against duty. And further, that considering the great opposition, which is found on the part of those who differ from us at home, no success can be expected among savages abroad, and that therefore it is against reason and experience.

In answer to this I say, that religion, like light, is imparted without being diminished. That whatever is done abroad, can be no hindrance or let to the conversion of infidels or others at home. That those who engage in this affair, imagine they will not be missed, where there is no want of schools or clergy;

but that they may be of singular service in countries but thinly supplied with either, or altogether deprived of both: that our colonies being of the same blood, language, and religion, with ourselves, are in effect our countrymen. But that Christian charity, not being limited by those regards, doth extend to all mankind. And this may serve for an answer to the first point, that our design is against duty.

To the second point I answer; that ignorance is not so incurable as error; that you must pull down as well as build, erase as well as imprint, in order to make proselytes at home: whereas, the savage Americans, if they are in a state purely natural, and unimproved by education, they are also unincumbered with all that rubbish of superstition and prejudice, which is the effect of a wrong one. As they are less instructed, they are withal less conceited and more teachable. And not being violently attached to any false system of their own, are so much the fitter to receive that which is true. Hence it is evident, that success abroad ought not to be measured by that which we observe at home, and that the inference, which was made from the difficulty of the one to the impossibility of the other, is altogether groundless.

It hath more the appearance of reason to object (what will possibly be objected by some) that this scheme hath been already tried to no purpose, several Indians having returned to their savage manners after they had been taught to write and read, and instructed in the Christian religion; a clear proof that their natural stupidity is not to be overcome by education.

In answer to this, I say, that the scheme now proposed hath never been tried, forasmuch as a thorough education in religion and morality, in divine and human learning, doth not appear to have been ever given to any savage American: that much is to be hoped from a man ripe in years, and well grounded in religion and useful knowledge, while little or nothing can be expected from a youth but slightly instructed in the elements of either: that from the miscarriage or gross stupidity of some, a general incapacity of all Americans cannot be fairly inferred: that they show as much natural sense as other uncultivated nations: that the empires of Mexico and Peru were evident proofs of their capacity, in which there appeared a reach of politics, and a degree of art and politeness, which no European people were ever known to have arrived at without the use of letters or of iron, and which some perhaps have fallen short of with both those advantages.

To what hath been said, it may not be improper to add, that young Americans, educated in an island at some distance from their own country, will more easily be kept under discipline till they have attained a complete education, than on the continent; where they might find opportunities of running away to their

countrymen, and returning to their brutal customs, before they were thoroughly imbued with good principles and habits.

It must nevertheless be acknowledged a difficult attempt, to plant religion among the Americans, so long as they continue their wild and roving life. He who is obliged to hunt for his daily food will have little curiosity or leisure to receive instruction. It would seem therefore the right way to introduce religion and civil life at the same time into that part of the world: either attempt will assist and promote the other. Those therefore of the young savages, who upon trial are found less likely to improve by academical studies, may be taught agriculture, or the most necessary trades. And when husbandmen, weavers, carpenters, and the like, have planted some useful arts among their savage countrymen, and taught them to live in settled habitations, to canton out their land and till it, to provide vegetable food of all kinds, to preserve flocks and herds of cattle, to make convenient houses, and to clothe themselves decently: this will assist the spreading the gospel among them; this will dispose them to social virtues, and enable them to see and to feel the advantages of a religious and civil education.

And that this view of propagating the gospel and civil life among the savage nations of America, was a principal motive which induced the crown to send the first English colonies thither, doth appear from the charter granted by king James I., to the adventurers in Virginia. See Purchas's Pilgrims, vol. iv. b. i. c. 9. And it is now but just (what might then seem charitable) that these poor creatures should receive some advantage wish respect to their spiritual interests, from those who have so much improved their temporal, by settling among them.

It is most true, notwithstanding our present corruptions, that there are to be found in no country under the sun men of better inclinations, or greater abilities for doing good, than in England. But it is as true, that success, in many cases, depends not upon zeal, industry, wealth, learning, or the like faculties, so much as on the method, wherein these are applied. We often see a small proportion of labour and expense in one way, bring that about, which in others a much greater share of both could never effect. It hath been my endeavour to discover this way or method in the present case. What hath been done, I submit to the judgment of all good and reasonable men; who, I am persuaded, will never reject or discourage a proposal of this nature, on the score of slight objections, surmises, or difficulties, and thereby render themselves chargeable with the having prevented those good effects, which might otherwise have been produced by it.

For it is after all possible, that unforeseen difficulties may arise in the prosecution of this design, many things may retard, and many things may threaten to obstruct it; but there is hardly

any enterprise or scheme whatsoever, for the public good, in which difficulties are not often showing themselves, and as often overcome by the blessing of God, upon the prudence and resolution of the undertakers; though, for ought that appears, the present scheme is as likely to succeed, and attended with as few difficulties, as any of this kind can possibly be.

For to any man, who considers the divine power of religion, the innate force of reason and virtue, and the mighty effects often wrought by the constant regular operation even of a weak and small cause, it will seem natural and reasonable to suppose that rivulets perpetually issuing forth from a fountain, or reservoir, of learning and religion, and streaming through all parts of America, must in due time have a great effect, in purging away the ill manners and irreligion of our colonies, as well as the blindness and barbarity of the nations round them: especially, if the reservoir be in a clean and private place, where its waters, out of the way of any thing that may corrupt them, remain clear and pure; otherwise they are more likely to pollute than purify the places through which they flow.

The greatness of a benefaction is rather in proportion to the number and want of the receivers, than to the liberality of the giver. A wise and good man would therefore be frugal in the management of his charity; that is, contrive it so as that it might extend to the greatest wants of the greatest number of his fellow creatures. Now the greatest wants are spiritual wants, and by all accounts these are no where greater than in our western plantations, in many parts whereof divine service is never performed for want of clergymen; in others, after such a manner and by such hands, as scandalize even the worst of their own parishioners; where many English, instead of gaining converts, are themselves degenerated into heathens, being members of no church, without morals, without faith, without baptism. There can be therefore, in no part of the Christiam world, a greater want of spiritual things than in our plantations.

And, on the other hand, no part of the gentile world are so inhuman and barbarous as the savage Americans, whose chief employment and delight consisting in cruelty and revenge, their lives must of all others be most opposite, as well to the light of nature as to the spirit of the gospel. Now to reclaim these poor wretches, to prevent the many torments and cruel deaths which they daily inflict on each other, to contribute in any sort to put a stop to the numberless horrid crimes which they commit without remorse, and instead thereof to introduce the practice of virtue and piety, must surely be a work in the highest degree becoming every sincere and charitable Christian.

Those, who wish well to religion and mankind, will need no other motive to forward an undertaking calculated for the service

of both: I shall, nevertheless, beg leave to observe, that whoever would be glad to cover a multitude of sins by an extensive and well judged charity, or whoever, from an excellent and godlike temper of mind, seeks opportunities of doing good in his generation, will be pleased to meet with a scheme that so peculiarly puts it in his power, with small trouble or expense, to procure a great and lasting benefit to the world.

Ten pounds a year, would (if I mistake not) be sufficient to defray the expense of a young American in the college of Bermuda, as to diet, lodging, clothes, books and education: and if so, the interest of two hundred pounds may be a perpetual fund for maintaining one missionary at the college for ever; and in this succession many, it is to be hoped, may become powerful instruments for converting to Christianity and civil life whole nations, who now sit in darkness and the shadow of death, and whose cruel brutal manners are a disgrace to human nature.

A benefaction of this kind seems to enlarge the very being of a man, extending it to distant places and to future times; inasmuch as unseen countries and after ages may feel the effects of his bounty, while he himself reaps the reward in the blessed society of all those, who, "having turned many to righteousness, shine as the stars for ever and ever."

VERSES,

ON THE

PROSPECT OF PLANTING ARTS AND LEARNING IN AMERICA.

THE Muse, disgusted at an age and clime,
Barren of every glorious theme,
In distant lands now waits a better time,
Producing subjects worthy fame:

In happy climes, where from the genial sun
And virgin earth such scenes ensue,
The force of art by nature seems outdone,
And fancied beauties by the true:

In happy climes, the seat of innocence,
Where nature guides and virtue rules,
Where men shall not impose for truth and sense,
The pedantry of courts and schools:

There shall be sung another golden age,
The rise of empire and of arts,
The good and great inspiring epic rage,
The wisest heads and noblest hearts.

Not such as Europe breeds in her decay:
Such as she bred when fresh and young,
When heavenly flame did animate her clay,
By future poets shall be sung.

Westward the course of empire take its way;
The four first acts already past,
A fifth shall close the drama with the day;
Time's noblest offspring is the last.

A SERMON,

PREACHED BEFORE THE

INCORPORATED SOCIETY FOR THE PROPAGATION OF THE GOSPEL IN FOREIGN PARTS,

AT THEIR ANNIVERSARY MEETING IN THE PARISH CHURCH OF ST. MARY-LE-BOW, ON FRIDAY, FEB. 18, 1731.

JOHN xvii. 3.

This is life eternal, that they may know thee the only true God, and Jesus Christ whom thou hast sent.

THAT human kind were not designed merely to sojourn a few days upon this earth: that a being of such excellence as the soul of man, so capable of a nobler life, and having such a high sense of things moral and intellectual, was not created in the sole view of being imprisoned in an earthly tabernacle, and partaking a few pains and pleasures which chequer this mortal life, without aspiring to any thing either above or beyond it, is a fundamental doctrine, as well of natural religion as of the Christian. It comes at once recommended by the authority of philosophers and evangelists. And that there actually is, in the mind of man, a strong instinct and desire, an appetite and tendency towards another and a better state, incomparably superior to the present, both in point of happiness and duration, is no more than every one's experience and inward feeling may inform him. The satiety and disrelish attending sensual enjoyments, the relish for things of a more pure and spiritual kind, the restless motion of the mind, from one terrene object or pursuit to another, and often a flight or endeavour above them all, towards something unknown and perfective of its nature, are so many signs and tokens of this better state, which, in the style of the gospel, is termed life eternal.

And as this is the greatest good that can befall us, the very end of our being, and that alone which can crown and satisfy our wishes, and without which we shall be ever restless and uneasy; so every man, who knows and acts up to his true interest, must make it his principal care and study to obtain it: and in order to this, he must endeavour to live suitably to his calling,

and of consequence endeavour to make others obtain it too. For how can a Christian show himself worthy of his calling, otherwise than by performing the duties of it? And what Christian duty is more essentially so, than that of charity? And what object can be found upon earth more deserving our charity, than the souls of men? Or, how is it possible for the most beneficent spirit to do them better service, than by promoting their best and most lasting interest, that is, by putting them in the way that leads to eternal life.

What this eternal life was, or how to come at it, were points unknown to the heathen world. It must be owned, the wise men of old, who followed the light of nature, saw even by that light, that the soul of man was debased, and borne downwards, contrary to its natural bent, by carnal and terrene objects; and that, on the other hand, it was exalted, purged, and in some sort assimilated to the Deity, by the contemplation of truth and practice of virtue. Thus much in general they saw or surmised. But then about the way and means to know the one, or perform the other, they were much at a loss. They were not agreed concerning the true end of mankind; which, as they saw, was mistaken in the vulgar pursuits of men; so they found it much more easy to confute the errors of others, than to ascertain the truth themselves. Hence, so many divisions and disputes about a point which it most imported them to know, insomuch as it was to give the bias to human life, and govern the whole tenor of their actions and conduct.

But when life and immortality were brought to light by the gospel, there could remain no dispute about the chief end and felicity of man, no more than there could about the means of obtaining it, after the express declaration of our blessed Lord in the words of my text; "this is life eternal, that they may know thee, the only true God, and Jesus Christ whom thou hast sent." For the right understanding of which words we must observe, that by the knowledge of God, is not meant a barren speculation, either of philosophers or scholastic divines, nor any notional tenets fitted to produce disputes and dissensions among men; but, on the contrary, an holy practical knowledge, which is the source, the root, or principle of peace and union, of faith, hope, charity, and universal obedience. A man may frame the most accurate notions, and, in one sense, attain the exactest knowledge of God and Christ that human faculties can reach, and yet, notwithstanding all this, be far from knowing them in that saving sense. For St. John tells us, that "whosoever sinneth, hath not seen Christ, nor known him."* And again, "he that loveth not, knoweth not God."† To know God as we ought, we must love him; and love him so as withal to love our

* 1 John iii. 6. † 1 John iv. 8.

brethren, his creatures, and his children. I say, that knowledge of God and Christ, which is life eternal, implies universal charity, with all the duties engrafted thereon, or ensuing from thence, that is to say, the love of God and man. And our Lord expressly saith, "he that hath my commandments, and keepeth them, he it is that loveth me."* From all which it is evident, that this saving knowledge of God is inseparable from the knowledge and practice of his will; the explicit declaration whereof, and of the means to perform it, are contained in the gospel, that divine instrument of grace and mercy to the sons of men. The metaphysical knowledge of God, considered in his absolute nature or essence, is one thing, and to know him as he stands related to us as Creator, Redeemer, and Sanctifier, is another. The former kind of knowledge (whatever it amounts to) hath been, and may be, in Gentiles as well as Christians, but not the latter, which is life eternal.

From what has been said, it is a plain consequence, that whoever is a sincere Christian, cannot be indifferent about bringing over other men to the knowledge of God and Christ; but that every one of us, who hath any claim to that title, is indispensably obliged, in duty to God, and in charity to his neighbour, to desire and promote, so far as there is opportunity, the conversion of heathens and infidels, that so they may become partakers of life and immortality. For "this is life eternal, to know thee the only true God, and Jesus Christ whom thou hast sent."

In my present discourse upon which words, I shall,

First, consider in general, the obligation that Christians lie under, of bringing other men to the knowledge of the only true God, and of Jesus Christ. And,

Secondly, I shall consider it in reference to this laudable society, instituted for the propagation of the gospel. And under each head, I propose to obviate such difficulties as may seem to retard, and intermix such remarks as shall appear proper to forward so good a work.

Now although it be very evident, that we can really have neither a just zeal for the glory of God, nor a beneficent love of man, without wishing and endeavouring, as occasion serves, to spread the glad tidings of salvation, and bring those who are benighted in the shadow of death, to life eternal, by the knowledge of the only true God, and of Jesus Christ whom he hath sent. Yet this duty, plain and undoubted as it seems, happens to be too often overlooked, even by those whose attention to other points would make one think their neglect of this, not an effect of lukewarm indifference, so much as of certain mistaken notions and suppositions. Two principal considerations occur,

* John xiv. 21.

which, in this particular, seem to have slackened the industry of some, otherwise zealous and serious Christians.

One I apprehend to be this, that it is surmised the Christian religion is in a declining state, which by many symptoms seems likely to end either in popery or a general infidelity. And that, of course, a prudent person has nothing to do but to make sure of his own salvation, and to acquiesce in the general tendency of things, without being at any fruitless pains to oppose what cannot be prevented, to steer against the stream, or resist a torrent, which as it flows gathers strength and rapidity, and in the end will be sure to overflow and carry all before it. When a man of a desponding and foreboding spirit hath been led, by his observation of the ways of the world, and the prevailing humour of our times, to think after this manner, he will be inclined to strengthen this his preconceived opinion, as is usual in other the like cases, by misapplication of holy scripture: for instance, by those words of our blessed Saviour, "when the Son of Man cometh, shall he find faith on the earth?"* which have been applied to this very purpose, as importing that before the final judgment Christian faith should be extinguished upon earth; although these words do, from the context, seem plainly to refer to the destruction of Jerusalem, and the obstinate blindness of the Jews, who, even when they felt the hand of God, should not acknowledge it, or believe the Roman army to be the instrument of divine vengeance, in the day of their visitation, by him whom they had injuriously treated, rejected, and put to death.

But, granting the former sense might be supported by no absurd hypothesis, or no improbable guess, yet shall the endeavours of Christian men for propagating the gospel of Christ be forestalled by any suppositions or conjectures whatsoever? Admitting, I say, those words regard the future advent of Jesus Christ, yet can any one tell how near or how far off that advent may be? Are not the times and seasons foreknown only to God? And shall we neglect a certain duty to day, upon an uncertain surmise of what is to come hereafter? This way of thinking might furnish as strong reasons against preaching at home, as abroad, within, as without the pale of the church. It would be as specious an argument against the one as the other, but in reality can conclude against neither. For, as we know not when that supposed time of general infidelity is to be, or whether it will be at all; so, if it were ever so sure, and ever so near, it would nevertheless become us to take care that it may not be an effect of our own particular indifference and neglect.

But if we take our notions, not from the uncertain interpretation of a particular text, but from the whole tenor of the divine oracles, from the express promise and reiterated predictions of

* Luke xviii. 8.

our blessed Lord and his apostles, we shall believe, that "Jesus Christ is highly exalted of God, to the end that at his name every knee shall bow, and every tongue confess that he is the Lord, to the glory of God the Father."* That "he must reign till he hath put all enemies under his feet."† That "he is with us alway, even unto the end of the world."‡ And that the church of the living God, the pillar and ground of truth, is so far from being destroyed by human means, "that the gates of hell,"—all the infernal powers,—"shall not prevail against it."§ Let us, therefore, banish all such conceits as may seem to justify our indolence, as may reason us out of all courage and vigour in the race that is set before us; let us not, I say, slacken our own hands, nor enfeeble our own knees, by preconceived fancies and suppositions, considering that as the success of all enterprises in great measure depends on the spirit of the undertakers, so nothing is more apt to raise a spirit than hope, nor to depress it than despondency. We ought, therefore, to shake off every vain fear in our spiritual warfare. The number, the presumption, and the abilities of those who take counsel together against the Lord and against his anointed, should not dishearten, but rather excite and encourage us to stand in the gap.

Another consideration that may possibly withhold divers sincere believers from contributing their endeavours for bringing men to the knowledge of God and Christ, and thereby to eternal life, is the want of miracles in the present age. Men naturally cast about for reasons to countenance the part they take. And as the gift of miracles was of mighty influence and help to those who were commissioned to spread abroad the light of the gospel in its first promulgation, so no pretence offers itself more naturally to excuse a man from executing any purpose than the want of authority, which, in the opinion of men, cannot be without a just commission, nor this unless distinguished by those proper means and powers that have been known to attend it. Now, with regard to this defect of miracles, I shall beg leave to make two observations.

First, it is to be observed, that if we have not miracles, we have other advantages which make them less necessary now than in the first spreading of the gospel. Whole nations have found the benefit of Christ's religion, it is protected by princes, established and encouraged by laws, supported by learning and arts, recommended by the experience of many ages, as well as by the authority and example of the wisest and most knowing men. Certainly, if the greatest part of mankind are Gentiles or Mahometans, it cannot be denied that the most knowing, most learned, and most improved nations, profess Christianity; and

* Phil. ii. 9—11. † 1 Cor. xv. 25. ‡ Matt. xxviii. 20.
§ Matt. xvi. 18.

that even the Mahometans themselves bear testimony to the divine mission of Jesus Christ. Whereas, therefore, in the beginning a few illiterate wanderers, of the meanest of the people, had the prejudices, the learning, and the power of their own, as well as other nations, in one word, the whole world, to oppose and overcome: those who at this day engage in the propagation of the gospel, do it upon terms in many respects far more easy and advantageous. It is power against weakness, civility against barbarism, knowledge against ignorance; some or other, if not all these advantages, in the present times, attending the progress of the Christian religion, in whatever part of the world men shall attempt to plant it.

In the second place we may reflect, that if we have not the gift of miracles, this is a good reason why we should exert more strongly those human means which God hath put in our power; and make our ordinary faculties, whether of the head, or the hand, or the tongue, our interest, our credit, or our fortune, subservient to the great Giver of them; and cheerfully contribute our humble mite towards hastening that time wherein "All nations whom thou hast made shall come and worship before thee, O Lord, and shall glorify thy name."* It is at least a plain case, that the want of apostolical gifts should not be pleaded as a bar to our doing that, which in no respect, either of difficulty or danger, equals or approaches the apostolical office. What pretence can this supply for men's being quite unconcerned about the spreading of the gospel, or the salvation of souls? for men's forgetting that they are Christians, and related to human kind? How can this justify their overlooking opportunities which lie in their way, their not contributing a small part of their fortune towards forwarding a design wherein they share neither pains nor peril; the not bestowing on it even the cheap assistance of their speech, attention, counsel, or countenance, as occasion offers? How unlike is this worldly, selfish indifference, to that account which St. Paul gives of himself, that "he sought not his own profit, but the profit of many, that they may be saved."† And yet herein he expected the Corinthians (and the same reason will hold for us) should be like him; for he subjoins, "be ye followers of me, as I also am of Christ."

Having considered the duty in general, I come now to treat of it with reference to America, the peculiar province of this venerable society; which I suppose well informed of the state and progress of religion in that part of the world, by their correspondencies with the clergy upon their mission. It may nevertheless be expected that one who had been engaged in a design upon this very view, who hath been upon the place, and resided a considerable time in one of our colonies, should have

* Psalm lxxxvi. 9. † 1 Cor. x. 33.

observed somewhat worth reporting. It is to be hoped, therefore, that one part of my audience will pardon, what the other may perhaps expect, while I detain them with the narrative of a few things I have observed, and such reflections as thereupon suggested themselves; some part of which may possibly be found to extend to other colonies.

Rhode-Island, with a portion of the adjacent continent, under the same government, is inhabited by an English colony, consisting chiefly of sectaries of many different denominations, who seem to have worn off part of that prejudice which they inherited from their ancestors against the national church of this land; though it must be acknowledged at the same time, that too many of them have worn off a serious sense of all religion. Several indeed of the better sort are accustomed to assemble themselves regularly on the Lord's day for the performance of divine worship. But most of those, who are dispersed throughout this colony, seem to rival some well-bred people of other countries, in a thorough indifference for all that is sacred, being equally careless of outward worship, and of inward principles, whether of faith or practice. Of the bulk of them it may certainly be said, that they live without the sacraments, not being so much as baptized: and as for their morals, I apprehend there is nothing to be found in them that should tempt others to make an experiment of their principles, either in religion or government. But it must be owned, the general behaviour of the inhabitants in those towns where churches and meetings have been long settled, and regularly attended, seems so much better, as sufficiently to show the difference, which a solemn regular worship of God makes between persons of the same blood, temper, and natural faculties.

The native Indians, who are said to have been formerly many thousands, within the compass of this colony, do not at present amount to one thousand, including every age and sex. And these are either all servants or labourers for the English, who have contributed more to destroy their bodies by the use of strong liquors, than by any means to improve their minds, or save their souls. This slow poison, jointly operating with the small-pox, and their wars (but much more destructive than both) hath consumed the Indians, not only in our colonies, but also far and wide upon our confines. And having made havock of them, is now doing the same thing by those who taught them that odious vice.

The negroes in the government of Rhode-Island are about half as many more than the Indians; and both together scarce amount to a seventh part of the whole colony. The religion of these people, as is natural to suppose, takes after that of their masters. Some few are baptized; several frequent the different assemblies: and far the greater part none at all. An ancient

antipathy to the Indians, whom, it seems, our first planters (therein as in certain other particulars affecting to imitate Jews rather than Christians) imagine they had a right to tread on the foot of Canaanites or Amalekites, together with an irrational contempt of the blacks, as creatures of another species, who had no right to be instructed or admitted to the sacraments, have proved a main obstacle to the conversion of these poor people.

To this may be added, an erroneous notion, that the being baptized, is inconsistent with a state of slavery. To undeceive them in this particular, which had too much weight, it seemed a proper step, if the opinion of his majesty's attorney and solicitor-general could be procured. This opinion they charitably sent over, signed with their own hands; which was accordingly printed in Rhode-Island, and dispersed throughout the plantations. I heartily wish it may produce the intended effect. It must be owned, our reformed planters, with respect to the natives and the slaves, might learn from those of the church of Rome, how it is their interest and duty to behave. Both French and Spaniards have intermarried with Indians, to the great strength, security, and increase of their colonies. They take care to instruct both them and their negroes, in the popish religion, to the reproach of those who profess a better. They have also bishops and seminaries for clergy; and it is not found that their colonies are worse subjects, or depend less on their mother country, on that account.

It should seem, that the likeliest step towards converting the heathen would be to begin with the English planters; whose influence will for ever be an obstacle to propagating the gospel, till they have a right sense of it themselves, which would show them how much it is their duty to impart it to others. The missionaries employed by this venerable society have done, and continue to do, good service, in bringing those planters to a serious sense of religion, which, it is hoped, will in time extend to others. I speak it knowingly, that the ministers of the gospel, in those provinces which go by the name of New-England, sent and supported at the expense of this society, have by their sobriety of manners, discreet behaviour, and a competent degree of useful knowledge, shown themselves worthy the choice of those who sent them; and particularly in living on a more friendly foot with their brethren of the separation; who, on their part, were also very much come off from that narrowness of spirit, which formerly kept them at such an unamicable distance from us. And as there is reason to apprehend, that part of America could not have been thus distinguished, and provided with such a number of proper persons, if one half of them had not been supplied out of the dissenting seminaries of the country, who in proportion as they attain to more liberal improvements of learning, are

observed to quit their prejudice towards an episcopal church; so I verily think it might increase the number of such useful men, if provision were made to defray their charges in coming hither to receive holy orders; passing and repassing the ocean, and tarrying the necessary time in London, requiring an expence that many are not able to bear. It would also be an encouragement to the missionaries in general, and probably produce good effects, if the allowance of certain missionaries were augmented, in proportion to the services they had done, and the time they had spent in their mission. These hints I venture to suggest, as not unuseful in an age, wherein all human encouragements are found more necessary, than at the first propagation of the gospel. But they are, with all due deference and respect, submitted to the judgment of this venerable audience.

After all, it is hardly to be expected, that so long as infidelity prevails at home, the Christian religion should thrive and flourish in our colonies abroad. Mankind, it must be owned, left to themselves, are so much bewildered, and benighted, with respect to the origin of that evil which they feel, and from which they are at a loss about the means of being freed; that the doctrines of the lapsed state of man, his reconciliation by Christ, and regeneration by the Spirit, may reasonably be hoped to find an easy admission, as bringing with them light and comfort, into a mind not hardened by impenitency, nor foreclosed by pride, nor biassed by prejudice. But, such is the vanity of man, that no prejudice operates more powerfully than that in favour of fashion; and no fashions are so much followed by our colonies, as those of the mother country, which they often adopt in their modes of living, to their great inconvenience, without allowing for the disparity of circumstance or climate. This same humour hath made infidelity (as I find it too credibly reported) spread in some of our wealthy plantations; uneducated men being more apt to tread in the steps of libertines and men of fashion than to model themselves by the laws and institutions of their mother country, or the lives and professions of the virtuous and religious part of it.

But this is not all; while those abroad are less disposed to receive, some at home are, perhaps, less disposed to propagate the gospel, from the same cause. It is to be feared, I say, that the prevailing torrent of infidelity, which staggers the faith of some, may cool the zeal and damp the spirit of others, who, judging from the event and success of those who impugn the church of Christ, may possibly entertain some scruple or surmise, whether it may not be, for the present at least, abandoned by providence, and that human care must ineffectually interpose, till it shall please God, "yet once more to shake not the earth only, but also the heavens." This point hath been touched before, but deserves

further consideration: to the end, that the peculiar impiety of a profane age, may not be a bar to those very endeavours, which itself renders more necessary, and calls for more loudly now than ever.

Whatever men may think, the arm of the Lord is not shortened. In all this prevalency of atheism and irreligion, there is no advantage gained by the powers of darkness, either against God, or godly men, but only against their own wretched partizans. The Christian dispensation is a dispensation of grace and favour. The Christian church a society of men entitled to this grace, on performing certain conditions. If this society is diminished, as those who remain true members of it suffer no loss to themselves, so God loseth no right, suffereth no detriment, foregoeth no good: his grace resisted or unfruitful, being no more lost to him, than the light of the sun shining on desert places, or among people who shut their eyes.

Besides, this excess, this unstemmed torrent of profaneness, may possibly, in the conclusion, defeat itself, confirm what it meant to extirpate, and instead of destroying, prove a means of preserving our religion; the evil fruits and effects thereof being so notorious and flagrant, and so sensibly felt, as in all likelihood to be able to open the eyes, and rouse the attention of those, who may be blind and deaf to every other argument and consideration. Or, who knows but the Christian Church corrupted by prosperity, is to be restored and purified by adversity? which may prove for ought we can tell, as salutary in future, as it hath been in past ages. Many insolent and presumptuous foes have set themselves against the church of God; whose hook nevertheless may be in their nostrils, and his bridle in their lips, managing and governing, even their rage and folly, to the fulfilling of his own wise purposes; and who may not fail in the end, to deal by them as he did by the king of Assyria, when he had "performed his work upon Sion and upon Jerusalem, punishing their stout heart and high looks." * This presumptuous conqueror was, without knowing it, a tool or instrument in the hands of that God whom he blasphemed. "O Assyrian, the rod of mine anger! I will send him against an hypocritical nation, and against the people of my wrath will I give him a charge to take the spoil, and to take the prey, and to tread them down like the mire of the streets. Howbeit he meaneth not so, neither doth his heart think so, but it is in his heart to destroy and cut off nations not a few." †

Thus much at least is evident: it is no new thing, that great enormities should produce great humiliations, and these again noble virtues, which have often recovered both single men, and whole states, even in a natural and civil sense. And if the captivities, distresses, and desolations of the Jewish church, have

* Isa. x. 12. † Isa. x. 5—7.

occasioned their return to God, and reinstated them in his favour; nay, if it was actually foretold, whenever they lay under the curse of God, at the mercy of their enemies, peeled and scattered in a foreign land, that nevertheless upon their calling his covenant to mind, and returning to him, "the Lord their God would turn their captivity, and have compassion them."* I say, if things were so, why may we not in reason hope for something analogous thereto, in behalf of the Christian church. It cannot be denied, that there was a great analogy between the Jewish institutions and the doctrines of the gospel; for instance, between the paschal lamb, and the Lamb of God slain from the foundation of the world; between the Egyptian bondage, and that of sin; the earthly Canaan, and the heavenly; the fleshly circumcision, and the spiritual. In these and many other particulars, the analogy seems so plain, that it can hardly be disputed. To be convinced that the law of Moses, and the Jewish economy were figures and shadows of the evangelical, we need only look into the epistle to the Hebrews. May we not therefore, in pursuance of this same analogy, suppose a similar treatment of the Jewish and Christian church?

Let us then see, on what terms the former stood with God, in order to discover what the latter may reasonably expect. The solemn denunciation to the Jews was, "If thou shalt hearken diligently unto the voice of the Lord thy God, to observe and to do all his commandments, which I command thee this day, that the Lord thy God will set thee on high above all the nations of the earth."† But in case of disobedience, it is added among many other threats and maledictions: "The Lord shall smite thee with blasting and with mildew: and thy heaven that is over thy head shall be brass, and the earth that is under thee shall be iron."‡ And again, "The Lord shall smite thee with madness, and blindness, and astonishment of heart."§ Have not the people of this land drawn down upon it, by more ways than one, the just judgments of heaven? Surely we have felt in a metaphor the first of the forementioned judgments; and the last hath been literally fulfilled upon us. Is it not visible that we are less knowing, less virtuous, less reasonable, in proportion as we are less religious? Are we not grown drunk and giddy with vice and vanity and presumption, and free-thinking, and extravagance of every kind? to a degree that we may truly be said to be "smitten with madness, and blindness, and astonishment of heart."

As anciently most unchristian schisms and disputes, joined with great corruption of manners, made way for the Mahometan in the east, and the papal dominion in the west; even so here at home in the last century, a weak reliance upon human politics

* Deut. xxx. 3. † Deut. xxviii. 1. ‡ Ver. 22, 23. § Deut. xxviii. 28.

and power on the one hand, and enthusiastic rage on the other, together with carnal mindedness on both, gave occasion to introduce atheism and infidelity. If the temporal state and outward form of the Jewish church was, upon their defection, overturned by invaders; in like manner, when Christians are no longer governed by the light of evangelical truth, when we resist the Spirit of God, are we not to expect, that "the heaven above will be as brass," that the divine grace will no longer shower down on our obdurate hearts, that our church and profession will be blasted by licentious scorners, those madmen, who in sport "scatter firebrands, arrows, and death?" As all this is no more than we may reasonably suppose will ensue upon our backsliding, so we may, with equal reason, hope it will be remedied upon our return to God.

From what hath been said it follows, that in order to propagate the gospel abroad, it is necessary we do it at home, and extend our charity to domestic infidels, if we would convert or prevent foreign ones. So that a view of the declining state of religion here at home, of those things that produced this declension, and of the proper methods to repair it, is naturally connected with the subject of this discourse. I shall therefore beg your patience, while I just mention a few remarks or hints, too obvious, perhaps, in themselves to be new or unknown to any present, but too little visible in their effects, to make one think they are, by all, much attended to.

Some, preferring points notional or ritual to the love of God and man, consider the national church only as it stands opposed to other Christian societies. These generally have a zeal without knowledge, and the effects are suitable to the cause; they really hurt what they seem to espouse. Others more solicitous about the discovery of truth than the practice of holiness, employ themselves rather to spy out errors in the church, than enforce its precepts. These, it is to be feared, postpone the great interests of religion to points of less concern, in any eyes but their own. But surely they would do well to consider, that an humble, though confused or indistinct faith in the bond of charity, and productive of good works, is much more evangelical than any accurate disputing and conceited knowledge.

A church which contains the fundamentals, and nothing subversive of those fundamentals, is not to be set at naught by any particular member; because it may not, in every point, perhaps, correspond with his ideas, no not, though he is sure of being in the right. Probably there never was, or will be, an established church in this world, without visible marks of humanity upon it. St. Paul supposeth, that "on the foundation of Jesus Christ, there will be human superstructures of hay and stubble,"* things

* 1 Cor. iii. 12.

light and trivial, wrong or superstitious, which indeed is a natural consequence of the weakness and ignorance of man. But where that living foundation is rightly laid in the mind, there will not fail to grow and spring from thence those virtues and graces, which are the genuine effects and tokens of true faith, and which are by no means inconsistent with every error in theory, or every needless rite in worship.

The Christian religion was calculated for the bulk of mankind, and therefore cannot reasonably be supposed to consist in subtle and nice notions. From the time that divinity was considered as a science, and human reason enthroned in the sanctuary of God, the hearts of its professors seem to have been less under the influence of grace. From that time have grown many unchristian dissensions and controversies, of men "knowing nothing, but doating about questions and strifes of words, whereof cometh envy, strife, railings, evil surmises, perverse disputings of men of corrupt minds, and destitute of truth."* Doubtless, the making religion a notional thing, hath been of infinite disservice. And whereas its holy mysteries are rather to be received with humility of faith, than defined and measured by the accuracy of human reason; all attempts of this kind, however well intended, have visibly failed in the event; and instead of reconciling infidels, have, by creating disputes and heats among the professors of Christianity, given no small advantage to its enemies.

To conclude, if we proportioned our zeal to the importance of things: if we could love men whose opinions we do not approve: if we knew the world more, and liked it less: if we had a due sense of the divine perfection and our own defects: if our chief study was the wisdom from above, described by St. Paul: and if, in order to all this, that were done in places of education, which cannot so well be done out of them: I say, if these steps were taken at home, while proper measures are carrying on abroad, the one would very much forward or facilitate the other. As it is not meant, so it must not be understood, that foreign attempts should wait for domestic success, but only that it is to be wished they may co-operate. Certainly if a just and rational, a genuine and sincere, a warm and vigorous piety, animated the mother-country, the influence thereof would soon reach our foreign plantations, and extend throughout their borders. We should soon see religion shine forth with new lustre and force, to the conversion of infidels, both at home and abroad, and to "the casting down imaginations, and every high thing that exalteth itself against the knowledge of God, and bringing into captivity every thought to the obedience of Christ."†

To whom with the Father, and the Holy Ghost, be ascribed all praise, might, majesty, and dominion, now and for ever.

* 1 Tim. vi. 4, 5. † 2 Cor. x. 5.

SIRIS:

A CHAIN OF

PHILOSOPHICAL REFLECTIONS AND INQUIRIES

CONCERNING

THE VIRTUES OF TAR WATER,

AND DIVERS OTHER SUBJECTS CONNECTED TOGETHER AND ARISING ONE FROM ANOTHER.

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SIRIS.

For introduction to the following piece I assure the reader, that nothing could, in my present situation, have induced me to be at the pains of writing it, but a firm belief that it would prove a valuable present to the public. What entertainment soever the reasoning or notional part may afford the mind, I will venture to say, the other part seemeth so surely calculated to do good to the body, that both must be gainers. For if the lute be not well tuned, the musician fails of his harmony. And in our present state, the operations of the mind so far depend on the right tone or good condition of its instrument, that any thing which greatly contributes to preserve or recover the health of the body, is well worth the attention of the mind. These considerations have moved me to communicate to the public the salutary virtues of tar water; to which I thought myself indispensably obliged, by the duty every man owes to mankind. And as effects are linked with their causes, my thoughts on this low but useful theme led to further inquiries, and those on to others remote, perhaps, and speculative, but I hope not altogether useless or unentertaining.

1. In certain parts of America, tar water is made by putting a quart of cold water to a quart of tar, and stirring them well together in a vessel, which is left standing till the tar sinks to the bottom. A glass of water being poured off for a draught, is replaced by the same quantity of fresh water, the vessel being shaken and left to stand as before. And this is repeated for every glass, so long as the tar continues to impregnate the water sufficiently, which appears by the smell and taste. But as this method produceth tar water of a nauseous kind, and different degrees of strength, I choose to make it in the following manner. Pour a gallon of cold water on a quart of tar, and stir, work and mix them thoroughly together with a wooden ladle or flat stick, for the space of five or six minutes; after which the vessel must stand close covered and unmoved three days and nights, that the tar may have full time to subside; and then the clear water, having been first carefully skimmed without shaking the vessel, is to be poured off, and kept in bottles well stopped for use,* no more

* I make this water stronger than that first prescribed in Siris, having found on more general experience, that five or six minutes stirring, when the water is carefully cleared and skimmed, agrees with most stomachs.

being made from the same tar, which may still serve for common uses.

2. The cold infusion of tar hath been used in some of our colonies as a preservative or preparative against the small-pox, which foreign practice induced me to try it in my own neighbourhood, when the small-pox raged with great violence. And the trial fully answered my expectation; all those, within my knowledge, who took the tar water having either escaped that distemper, or had it very favourably. In one family there was a remarkable instance of seven children, who came all very well through the small-pox, except one young child which could not be brought to drink tar water as the rest had done.

3. Several were preserved from taking the small-pox by the use of this liquor: others had it in the mildest manner, and others that they might be able to take the infection, were obliged to intermit drinking the tar water. I have found it may be drunk with great safety and success for any length of time, and this not only before, but also during the distemper. The general rule for taking it is, about half a pint night and morning on an empty stomach, which quantity may be varied, according to the case and age of the patient, provided it be always taken on an empty stomach, and about two hours before or after a meal. For children and squeamish persons it may be made weaker or given little and often, more water or less stirring makes it weaker, as less water or more stirring makes it stronger. It should not be lighter than French, nor deeper coloured than Spanish white wine; if a spirit be not very sensibly perceived on drinking, either the tar must have been bad or already used, or the tar water carelessly made or kept. Particular experience will best show how much and how strong the stomach can bear, and what are the properest terms for taking it. I apprehend no danger from excess in the use of this medicine.

4. It seemed probable, that a medicine of such efficacy in a distemper attended with so many purulent ulcers, might be also useful in other foulnesses of the blood, accordingly I tried it on several persons infected with cutaneous eruptions and ulcers, who were soon relieved, and soon after cured. Encouraged by these successes, I ventured to advise it in the foulest distempers, wherein it proved much more successful than salivations and wood drinks had done.

5. Having tried it in a great variety of cases, I found it succeeded beyond my hopes; in a tedious and painful ulceration of the bowels, in a consumptive cough and (as appeared by expectorated pus) an ulcer in the lungs; in a pleurisy and peripneumony. And when a person who for some years had been subject to erysipelatous fevers, perceived the usual forerunning symptoms to come on, I advised her to drink tar water, which prevented erysipelas.

6. I never knew any thing so good for the stomach as tar water: it cures indigestion and gives a good appetite. It is an excellent medicine in an asthma. It imparts a kindly warmth an dquick circulation to the juices without heating, and is therefore useful, not only as a pectoral and balsamic, but also as a powerful and safe deobstruent in cachectic and hysteric cases. As it is both healing and diuretic, it is very good for the gravel. I believe it to be of great use in a dropsy, having known it cure a very bad anasarca in a person whose thirst, though very extraordinary, was in a short time removed by the drinking of tar water.

7. The usefulness of this medicine in inflammatory cases is evident, from what has been already observed.* And yet some perhaps may suspect that, as the tar itself is sulphureous, tar water must be of a hot and inflaming nature. But it is to be noted that all balsams contain an acid spirit, which is in truth a volatile salt. Water is a menstruum that dissolves all sorts, and draws them from their subjects. Tar, therefore, being a balsam, its salutary acid is extracted by water, which yet is incapable of dissolving its gross, resinous parts, whose proper menstruum is spirit of wine. Therefore tar water, not being impregnated with resin, may be safely used in inflammatory cases: and in fact it hath been found an admirable febrifuge, at once the safest cooler and cordial.

8. The volatile salts separated by infusion from tar, may be supposed to contain its specific virtues. Mr. Boyle and other later chemists are agreed, that fixed salts are much the same in all bodies. But it is well known that volatile salts do greatly differ; and the easier they are separated from the subject, the more do they possess of its specific qualities. Now the most easy separation is by infusion of tar in cold water, which to smell and taste showing itself well impregnated, may be presumed to extract and retain the most pure volatile and active particles of that vegetable balsam.

9. Tar was by the ancients esteemed good against poisons, ulcers, the bites of venomous creatures, also for phthisical scrofulous, paralytic, and asthmatic persons. But the method of rendering it an inoffensive medicine, and agreeable to the stomach by extracting its virtues in cold water, was unknown to them. The leaves and tender tops of pine and fir are in our times used for diet drinks, and allowed to be antiscorbutic and diuretic. But the most elaborate juice, salt, and spirit of these evergreens are to be found in tar; whose virtues extend not to animals alone, but also to vegetables. Mr. Evelyn, in his treatise on forest trees, observes with wonder, that stems of trees, smeared over with tar, are preserved thereby from being hurt by

* Sect. 5.

the envenomed teeth of goats and other injuries, while every other thing of an unctuous nature is highly prejudicial to them.

10. It seems that tar and turpentine may be had, more or less, from all sorts of pines and firs whatsoever; and that the native spirits and essential salts of those vegetables are the same in turpentine and common tar. In effect, this vulgar tar, which cheapness and plenty may have rendered contemptible, appears to be an excellent balsam, containing the virtues of most other balsams which it easily imparts to water, and by that means readily and inoffensively insinuates them into the habit of the body.

11. The resinous exsudations of pines and firs are an important branch of the *materia medica*, and not only useful in the prescriptions of physicians, but have been also thought otherwise conducive to health. Pliny tells us, that wines in the time of the old Romans were medicated with pitch and resin; and Jonstonus, in his Dendrographia, observes, that it is wholesome to walk in groves of pine-trees, which impregnate the air with balsamic particles. That all turpentines and resins are good for the lungs, against gravel also and obstructions, is no secret. And that the medicinal properties of those drugs are found in tar-water, without heating the blood, or disordering the stomach, is confirmed by experience; and particularly that phthisical and asthmatic persons receive speedy and great relief from the use of it.

12. Balsams, as all unctuous and oily medicines, create a nauseating in the stomach. They cannot, therefore, be taken in substance so much or so long as to produce all those salutary effects, which, if thoroughly mixed with the blood and juices, they would be capable of producing. It must, therefore, be a thing of great benefit to be able to introduce any requisite quantity of their volatile parts into the finest ducts and capillaries, so as not to offend the stomach, but, on the contrary, to comfort and strengthen it in a great degree.

13. According to Pliny, liquid pitch (as he calls it), or tar, was obtained by setting fire to billets of old fat pines or firs. The first running was tar, the later or thicker running was pitch. Theophrastus is more particular: he tells us the Macedonians made huge heaps of the cloven trunks of those trees, wherein the billets were placed erect beside each other. That such heaps or piles of wood were sometimes a hundred and eighty cubits round, and sixty or even a hundred high: and that having covered them with sods of earth to prevent the flame from bursting forth (in which case the tar was lost) they set on fire those huge heaps of pine or fir, letting the tar or pitch run out in a channel.

14. Pliny saith, it was customary for the ancients to hold

fleeces of wool over the steam of boiling tar, and squeeze the moisture from them, which watery substance was called *pissinum*. Ray will have this to be the same with the pisselæum of the ancients; but Hardouin, in his notes on Pliny, thinks the pisselæum to have been produced from the cones of cedars. What use they made of these liquors anciently I know not; but it may be presumed they were used in medicine, though at present, for ought I can find, they are not used at all.

15. From the manner of procuring tar,* it plainly appears to be a natural production, lodged in the vessels of the tree whence it is only freed and let loose (not made) by burning. If we may believe Pliny, the first running or tar was called cedrium, and was of such efficacy to preserve from putrefaction, that in Egypt they embalmed dead bodies with it. And to this he ascribes their mummies continuing uncorrupted for so many ages.

16. Some modern writers inform us that tar flows from the trunks of pines and firs when they are very old, through incisions made in the bark near the root. That pitch is tar inspissated: and both are the oil of the tree grown thick and ripened with age and sun. The trees, like old men, being unable to perspire, and their secretory ducts obstructed, they are, as one may say, choaked and stuffed with their own juice.

17. The method used by our colonies in America for making tar and pitch, is in effect the same with that of the ancient Macedonians; as appears from the account given in the Philosophical Transactions. And the relation of Leo Africanus, who describes, as an eye witness, the making of tar on mount Atlas agrees in substance with the methods used by the Macedonians of old, and the people of New England at this day.

18. Jonstonus, in his Dendrographia, is of opinion that pitch was anciently made of cedar, as well as of the pine and fir grown old and oily. It should seem, indeed, that one and the same word was used by the ancients in a large sense, so as to comprehend the juices issuing from all those trees. Tar and all sorts of exsudations from evergreens, are, in a general acceptation, included under the name resin. Hard coarse resin, or dry pitch, is made from tar by letting it blaze till the moisture is spent. Liquid resin is properly an oily viscid juice oozing from the bark of evergreen trees, either spontaneously or by incision. It is thought to be the oil of the bark inspissated by the sun. As it issues from the tree it is liquid, but becomes dry and hard being condensed by the sun or by fire.

19. According to Theophrastus, resin was obtained by stripping off the bark from pines, and by incisions made in the silver fir and the pitch pine. The inhabitants of mount Ida, he tells us, stripped the trunk of the pine on the sunny side two or three

* Sect. 13.

cubits from the ground. He observes that a good pine might be made to yield resin every year; an indifferent every other year, and the weaker trees once in three years; and that three runnings were as much as a tree could bear. It is remarkable by the same author, that a pine doth not at once bear fruit and resin, but the former only in its youth, the latter in its old age.

20. Turpentine is a fine resin. Four kinds of this are in use. The turpentine of Chios or Cyprus, which flows from the turpentine tree; the Venice turpentine, which is got by piercing the larch-tree; the Strasburgh turpentine, which Mr. Ray informs us is procured from the knots of the silver fur, it is fragrant and grows yellow with age; the fourth kind is common turpentine, neither transparent nor so liquid as the former; and this Mr. Ray taketh to flow from the mountain pine. All these turpentines are useful in the same intentions. Theophrastus saith the best resin or turpentine is got from the terebinthus growing in Syria and some of the Greek islands. The next best from the silver fir and pitch pine.

21. Turpentine is on all hands allowed to have great medicinal virtues. Tar and its infusion contain those virtues. Tar water is extremely pectoral and restorative, and if I may judge, from what experience I have had, it possesseth the most valuable qualities ascribed to the several balsams of Peru, of Tolu, of Capivi, and even to the balm of Gilead, such is its virtue in asthmas and pleurisies, in obstructions and ulcerous erosions of the inward parts. Tar in substance mixed with honey I have found an excellent medicine for coughs. Balsams, as hath been already observed, are apt to offend the stomach. But tar water may be taken without offending the stomach. For the strengthening whereof it is the best medicine I have ever tried.

22. The folly of man rateth things by their scarceness, but providence hath made the most useful things most common. Among those liquid, oily extracts from trees and shrubs which are termed balsams, and valued for medicinal virtues, tar may hold its place as a most valuable balsam. Its fragrancy showeth that it is possessed of active qualities, and its oiliness that it is fitted to retain them. This excellent balsam may be purchased for a penny a pound, whereas the balsam of Judea, when most plentiful, was sold on the very spot that produced it for double its weight in silver, if we may credit Pliny; who also informs us that the best balsam of Judea flowed only from the bark, and that it was adulterated with resin and oil of turpentine. Now, comparing the virtues I have experienced in tar with those I find ascribed to the precious balm of Judæ, of Gilead, or of Meccha, as it is diversly called, I am of opinion that the latter is not a medicine of more value or efficacy than the former.

23. Pliny supposed amber to be a resin, and to distil from

some species of pine, which he gathered from its smell. Nevertheless its being dug out of the earth shows it to be a fossil, though of a very different kind from other fossils. But thus much is certain, that the medicinal virtues of amber are to be found in the balsamic juices of pines and firs. Particularly the virtues of the most valuable preparation, I mean salt of amber, are in a great degree answered by tar water, as a detergent, diaphoretic, and diuretic.

24. There is, as hath been already observed, more or less oil and balsam in all evergreen trees, which retains the acid spirit, that principle of life and verdure; the not retaining whereof in sufficient quantity causeth other plants to droop and wither. Of these evergreen trees, productive of resin, pitch, and tar, Pliny enumerates six kinds in Europe; Jonstonus reckons up thrice that number of the pine and fir family. And indeed their number, their variety, and their likeness, makes it difficult to be exact.

25. It is remarked both by Theophrastus and Jonstonus, that trees growing in low and shady places do not yield so good tar as those which grow in higher and more exposed situations. And Theophrastus further observes, that the inhabitants of Mount Ida, in Asia, who distinguish the Idæan pine from the maritime, affirm, that the tar flowing from the former is in greater plenty, as well as more fragrant than the other. Hence it should seem, the pines or firs in the mountains of Scotland might be employed that way, and rendered valuable, even where the timber, by its remoteness from water carriage, is of small value. What we call the Scotch fir is falsely so called, being in truth a wild forest pine, and, as Mr. Ray informs us, agreeing much with the description of a pine growing on Mount Olympus, in Phrygia, probably the only place where it is found out of these islands; in which of late years it is so much planted and cultivated with so little advantage, while the cedar of Lebanon might perhaps be raised with little more trouble, and much more profit and ornament.

26. The pines, which differ from the firs in the length and disposition of their leaves and hardness of the wood, do not, in Pliny's account, yield so much resin as the fir trees. Several species of both are accurately described and delineated by the naturalists. But they all agree so far as to seem related. Theophrastus gives the preference to that resin which is got from the silver fir and pitch tree (ἐλάτη and πίτυς), before that yielded by the pine, which yet, he saith, is in greater plenty. Pliny, on the contrary, affirms that the pine produceth the smallest quantity. It should seem, therefore, that the interpreter of Theophrastus might have been mistaken, in rendering πεύκη by pinus, as well as Jonstonus, who likewise takes the pine for the πεύκη of Theophrastus. Hardouin will have the pinus of Pliny to

have been by others called πεύκη, but by Theophrastus πίτυς. Ray thinks the common fir, or picea, of the Latins, to be the male fir of Theophrastus. This was probably the spruce fir; for the picea, according to Pliny, yields much resin, loves a cold and mountainous situation, and is distinguished, *tonsili facilitate*, by its fitness to be shorn, which agrees with the spruce fir, whereof I have seen close shorn hedges.

27. There seems to have been some confusion in the naming of these trees, as well among the ancients as the moderns. The ancient Greek and Latin names are by later authors applied very differently. Pliny himself acknowledgeth, it is not easy even for the skilful to distinguish the trees by their leaves, and know their sexes and kinds: and that difficulty is since much increased, by the discovery of many new species of that ever green tribe, growing in various parts of the globe. But descriptions are not so easily misapplied as names. Theophrastus tells, that πίτυς differeth from πεύκη, among other things, in that it is neither so tall nor so straight, nor hath so large a leaf. The fir he distinguisheth into male and female; the latter is softer timber than the male; it is also a taller and fairer tree, and this is probably the silver fir.

28. To say no more on this obscure business, which I leave to the critics, I shall observe that, according to Theophrastus, not only the turpentine trees, the pines, and the firs, yield resin or tar, but also the cedars and palm trees; and the words *pix* and *resina* are taken by Pliny in so large a sense as to include the weepings of the Lentiscus and Cypress, and the balms of Arabia and Judæa; all which perhaps are near of kin, and in their most useful qualities concur with common tar, especially the Norwegian, which is the most liquid and best for medicinal uses of any that I have experienced. Those trees that grow on mountains, exposed to the sun or the north wind, are reckoned by Theophrastus to produce the best and purest tar: and the Idæan pines were distinguished from those growing on the plain, as yielding a thinner, sweeter, and better scented tar: all which differences I think I have observed between the tar that comes from Norway, and that which comes from low and swampy countries.

29. Agreeable to the old observation of the Peripatetics, that heat gathereth homogeneous things and disperseth such as are heterogeneous, we find chemistry is fitted for the analysis of bodies. But the chemistry of nature is much more perfect than that of human art, inasmuch as it joineth to the power of heat that of the most exquisite mechanism. Those who have examined the structure of trees and plants by microscopes, have discovered an admirable variety of fine capillary tubes and vessels, fitted for several purposes, as the imbibing or attracting of proper nourishment, the distributing thereof through all parts of the vegetable,

the discharge of superfluities, the secretion of particular juices. They are found to have ducts answering to the tracheæ in animals, for the conveying of air; they have others answering to lacteals, arteries, and veins. They feel, digest, respire, perspire, and generate their kind, and are provided with organs nicely fitted for all those uses.

30. The sap vessels are observed to be fine tubes, running up through the trunk from the root. Secretory vessels are found in the bark, buds, leaves, and flowers. Exhaling vessels, for carrying off excrementitious parts, are discovered throughout the whole surface of the vegetable. And (though this point be not so well agreed) Dr. Grew, in his anatomy of plants, thinks there appears a circulation of the sap, moving downwards in the root, and feeding the trunk upwards.

31. Some difference indeed there is between learned men, concerning the proper use of certain parts of vegetables. But whether the discoverers have rightly guessed at all their uses or no, thus much is certain, that there are innumerable fine and curious parts in a vegetable body, and a wonderful similitude or analogy between the mechanism of plants and animals. And, perhaps, some will think it not unreasonable to suppose the mechanism of plants more curious than even that of animals, if we consider, not only the several juices secreted by different parts of the same plant, but also the endless variety of juices drawn and formed out of the same soil, by various species of vegetables; which must therefore differ in an endless variety, as to the texture of their absorbent vessels and secretory ducts.

32. A body, therefore, either animal or vegetable, may be considered as an organized system of tubes and vessels, containing several sorts of fluids. And as fluids are moved through the vessels of animal bodies by the systole and diastole of the heart, the alternate expansion and condensation of the air, and the oscillations in the membranes and tunics of the vessels; even so by means of air, expanded and contracted in the tracheæ or vessels made up of elastic fibres, the sap is propelled through the arterial tubes of a plant, and the vegetable juices, as they are rarefied by heat or condensed by cold, will either ascend and evaporate into air, or descend in the form of a gross liquor.

33. Juices, therefore, first purified by straining through the fine pores of the root, are afterwards exalted by the action of the air and vessels of the plant; but, above all, by the action of the sun's light; which, at the same time that it heats, doth wonderfully rarefy and raise the sap, till it perspires and forms an atmosphere, like the effluvia of animal bodies. And though the leaves are supposed to perform principally the office of lungs, breathing out excrementitious vapours and drawing in alimentary; yet it seems probable, that the reciprocal actoins of

repulsion and attraction, are performed all over the surface of vegetables, as well as animals. In which reciprocation, Hippocrates supposeth the manner of nature's acting, for the nourishment and health of animal bodies chiefly to consist. And, indeed, what share of a plant's nourishment is drawn through the leaves and bark, from that ambient heterogeneous fluid called air, is not easy to say. It seems very considerable and altogether necessary, as well to vegetable as animal life.

34. It is an opinion received by many, that the sap circulates in plants as the blood in animals: that it ascends through capillary arteries in the trunk, into which are inosculated other vessels of the bark answering to veins, which bring back to the root the remainder of the sap, over and above what had been deposited, during its ascent by the arterial vessels, and secreted for the several uses of the vegetable throughout all its parts, stem, branches, leaves, flowers, and fruit. Others deny this circulation, and affirm that the sap doth not return through the bark vessels. It is nevertheless agreed by all, that there are ascending and descending juices; while some will have the ascent and descent to be a circulation of the same juices through different vessels: others will have the ascending juice to be one sort attracted by the root, and the descending another, imbibed by the leaves, or extremities of the branches: lastly, others think that the same juice, as it is rarefied or condensed by heat or cold, rises and subsides in the same tube. I shall not take upon me to decide this controversy. Only I cannot help observing, that the vulgar argument from analogy, between plants and animals loseth much of its force, if it be considered, that the supposed circulating of the sap, from the root or lacteals through the arteries, and thence returning, by inosculations, through the veins or bark vessels to the root or lacteals again, is in no sort conformable or analogous to the circulation of the blood.

35. It is sufficient to observe, what all must acknowledge, that a plant or tree is a very nice and complicated machine;* by the several parts and motions whereof, the crude juices admitted through the absorbent vessels, whether of the root, trunk, or branches, are variously mixed, separated, altered, digested, and exalted, in a very wonderful manner. The juice, as it passeth in and out, up and down, through tubes of different textures, shapes, and sizes, and is affected by the alternate compression and expansion of elastic vessels, by the vicissitudes of seasons, the changes of weather, and the various action of the solar light, grows still more and more elaborate.

36. There is therefore no chemistry like that of nature, which addeth to the force of fire the most delicate, various, and artificial percolation.† The incessant action of the sun upon the

* Sect. 30, 31. † Sect. 29.

elements of air, earth, and water, and on all sorts of mixed bodies, animal, vegetable, and fossil, is supposed to perform all sorts of chemical operations. Whence it should follow, that the air contains all sorts of chemic productions, the vapours, fumes, oils, salts, and spirits, of all the bodies we know: from which general aggregate or mass, those that are proper being drawn in through the fine vessels of the leaves, branches, and stem of the tree, undergo, in its various organs, new alterations, secretions, and digestions, till such time as they assume the most elaborate form.

37. Nor is it to be wondered, that the peculiar texture of each plant or tree, co-operating with the solar fire and pre-existing juices, should so alter the fine nourishment drawn from earth and air,* as to produce various specific qualities of great efficacy in medicine; especially if it be considered, that in the opinion of learned men, there is an influence on plants derived from the sun, besides its mere heat. Certainly Dr. Grew, that curious anatomist of plants, holds the solar influence to differ from that of a mere culinary fire, otherwise than by being only a more temperate and equal heat.

38. The alimentary juice taken into the lacteals, if I may so say, of vegetables, consists of oily, aqueous, and saline particles, which, being dissolved, volatilized, and diversly agitated, part thereof is spent and exhaled into the air; and that part which remains is, by the economy of the plant and action of the sun, strained, purified, concocted, and ripened into an inspissated oil or balsam, and deposited in certain cells placed chiefly in the bark, which is thought to answer the *panniculus adiposus* in animals, defending trees from the weather, and, when in sufficient quantity, rendering them evergreen. This balsam, weeping or sweating through the bark, hardens into resin; and this most copiously in the several species of pines and firs, whose oil being in greater quantity, and more tenacious of the acid spirit or vegetable soul (as perhaps it may not improperly be called) abides the action of the sun, and attracting the sun beams, is thereby exalted and enriched, so as to become a most noble medicine; such is the last product of a tree, perfectly maturated by time and sun.

39. It is remarked by Theophrastus, that all plants and trees while they put forth have most humour, but when they have ceased to germinate and bear, then the humour is strongest, and most showeth the nature of the plant, and that, therefore, trees yielding resin should be cut after germination. It seems also very reasonable to suppose the juice of old trees, whose organs bring no new sap, should be better ripened than that of others.

40. The aromatic flavours of vegetables seem to depend upon

* Sect. 33.

the sun's light, as much as colours. As in the production of the latter, the reflecting power of the object, so in that of the former, the attractive and organical powers of the plant co-operate with the sun.* And as from Sir Isaac Newton's experiments it appears, that all colours are virtually in the white light of the sun, and show themselves when the rays are separated by the attracting and repelling powers of objects, even so the specific qualities of the elaborate juices of plants seem to be virtually or eminently contained in the solar light, and are actually exhibited upon the separation of the rays, by the peculiar powers of the capillary organs in vegetables, attracting and imbibing certain rays, which produce certain flavours and qualities, in like manner as certain rays being reflected, produce certain colours.

41. It hath been observed by some curious anatomists, that the secretory vessels in the glands of animal bodies are lined with a fine down, which in different glands is of different colours. And it is thought, that each particular down, being originally imbued with its own proper juice, attracts none but that sort; by which means so many various juices are secreted in different parts of the body. And perhaps there may be something analogous to this, in the fine absorbent vessels of plants, which may co-operate towards producing that endless variety of juices elaborated in plants from the same earth and air.

42. The balsam or essential oil of vegetables contains a spirit, wherein consist the specific qualities, the smell and taste of the plant. Boerhaave holds the native presiding spirit to be neither oil, salt, earth, or water; but somewhat too fine and subtile to be caught alone and rendered visible to the eye. This when suffered to fly off, for instance, from the oil of rosemary, leaves it destitute of all flavour. This spark of life, this spirit or soul, if we may so say, of the vegetable departs without any sensible diminution of the oil or water wherein it was lodged.

43. It should seem that the forms, souls, or principles of vegetable life, subsist in the light or solar emanation,* which in respect of the macrocosm is what the animal spirit is to the microcosm; the interior tegument, the subtile instrument and vehicle of power. No wonder then that the *ens primum* or *scintilla spirituosa*, as it is called, of plants should be a thing so fine and sagacious as to escape our nicest search. It is evident that nature at the sun's approach vegetates, and languishes at his recess; this terrestial globe seeming only a matrix disposed and prepared to receive life from his light; whence Homer in his hymns styleth earth the wife of heaven, ἄλοχ' οὐρανοῦ ἀστερόεντος.

44. The luminous spirit which is the form or life of a plant, from whence its differences and properties flow, is somewhat

* Sect. 36, 37. † Sect. 40.

extremely volatile. It is not the oil, but a thing more subtile whereof oil is the vehicle, which retains it from flying off, and is lodged in several parts of the plant, particularly in the cells of the bark and in the seeds. This oil purified and exalted by the organical powers of the plant, and agitated by warmth, becomes a proper receptacle of the spirit; part of which spirit exhales through the leaves and flowers, and part is arrested by this unctuous humour that detains it in the plant. It is to be noted this essential oil animated, as one may say, with the flavour of the plant is very different from any spirit, that can be procured from the same plant by fermentation.

45. Light impregnates air,* air impregnates vapour; and this becomes a watery juice by distillation having risen first in the cold still with a kindly gentle heat. This fragrant vegetable water is possessed of the specific odour and taste of the plant. It is remarked that distilled oils added to water for counterfeiting the vegetable water can never equal it, artificial chymistry falling short of the natural.

46. The less violence is used to nature the better its produce. The juice of olives or grapes issuing by the lightest pressure is best. Resins that drop from the branches spontaneously, or ooze upon the slightest incision, are the finest and most fragrant. And infusions are observed to act more strongly than decoctions of plants, the more subtile and volatile salts and spirits, which might be lost or corrupted by the latter, being obtained in their natural state by the former. It is also observed that the finest, purest, and most volatile part is that which first ascends in distillation. And, indeed it should seem the lightest and most active particles required least force to disengage them from the subject.

47. The salts, therefore, and more active spirits of the tar are got by infusion in cold water: but the resinous part is not to be dissolved thereby.† Hence the prejudice which some perhaps may entertain against tar water, as a medicine, the use whereof might inflame the blood by its sulphur and resin, appears to be not well grounded; it being indeed impregnated with a fine acid spirit, balsamic, cooling, diuretic, and possessed of many other virtues.‡ Spirits are supposed to consist of salts and phlegm, probably too somewhat of a fine oily nature, differing from oil in that it mixeth with water, and agreeing with oil, in that it runneth in rivulets by distillation. Thus much is allowed, that the water, earth, and fixed salt are the same in all plants; that, therefore, which differenceth a plant or makes it what it is, the native spark or form, in the language of the chymists or schools, is none of those things, nor yet the finest oil, which seemeth only its receptacle or vehicle. It is observed by chymists, that all

* Sect. 37, 43. † Sect. 7. ‡ Sect. 42. 44.

sorts of balsamic would afford an acid spirit, which is the volatile oily salt of the vegetable: herein are chiefly contained their medicinal virtues, and by the trials I have made, it appears, that the acid spirit in tar water, possesseth the virtues, in an eminent degree, of that of guaiacum, and other medicinal woods.

48. Qualities in a degree too strong for human nature to subdue and assimilate to itself, must hurt the constitution. All acids, therefore, may not be useful or innocent. But this seemeth an acid so thoroughly concocted, so gentle, bland, and temperate, and withal a spirit so fine and volatile, as readily to enter the smallest vessels, and be assimilated with the utmost ease.

49. If any one were minded to dissolve some of the resin, together with the salt or spirit, he need only mix some spirit of wine with the water. But such an entire solution of resins and gums, as to qualify them for entering and pervading the animal system, like the fine acid spirit, that first flies off from the subject, is perhaps impossible to obtain. It is an apothegm of the chymists, derived from Helmont, that whoever can make myrrh soluble by the human body, has the secret of prolonging his days: and Boerhaave owns that there seems to be truth in this, from its resisting putrefaction. Now this quality is as remarkable in tar, with which the ancients embalmed and preserved dead bodies. And though Boerhaave himself, and other chymists before him, have given methods for making solutions of myrrh, yet it is by means of alcohol which extracts only the inflammable parts. And it doth not seem that any solution of myrrh is impregnated with its salt or acid spirit. It may not, therefore, seem strange if this water should be found more beneficial for procuring health and long life, than any solution of myrrh whatsoever.

50. Certainly divers resins and gums may have virtues, and yet not be able for their grossness to pass the lacteals and other finer vessels, nor yet, perhaps, readily impart those virtues to a *menstruum*, that may with safety and speed convey them throughout the human body. Upon all which accounts, I believe tar water will be found to have singular advantages. It is observed that acid spirits prove the stronger, by how much the greater degree of heat is required to raise them. And indeed, there seemeth to be no acid more gentle than this, obtained by the simple effusion of cold water; which carries off from the subject the most light and subtile parts, and, if one may so speak, the very flower of its specific qualities. And here it is to be noted, that the volatile salt and spirit of vegetables do, by gently stimulating the solids, attenuate the fluids contained in them, and promote secretions, and that they are penetrating and active, contrary to the general nature of other acids.

51. It is a great maxim for health, that the juices of the body be kept fluid in a due proportion. Therefore, the acid volatile

spirit in tar water, at once attenuating and cooling in a moderate degree, must greatly conduce to health, as a mild salutary deobstruent, quickening the circulation of the fluids without wounding the solids, thereby gently removing or preventing those obstructions, which are the great and general cause of most chronical diseases; in this manner answering to the antihysterics, asafœtida, galbanum, myrrh, amber, and in general, to all the resins and gums of trees or shrubs useful in nervous cases.

52. Warm water is itself a deobstruent. Therefore the infusion of tar drunk warm, is easier insinuated into all the nice capillary vessels, and acts, not only by virtue of the balsam, but also by that of the vehicle. Its taste, its diurectic quality, its being so great a cordial, show the activity of this medicine. And at the same time that it quickens the sluggish blood of the hysterical, its balsamic oily nature abates the too rapid motion of the sharp thin blood in those who are hectic. There is a lentor and smoothness in the blood for healthy strong people, on the contrary, there is often an acrimony and solution in that of weakly morbid persons. The fine particles of tar are not only warm and active, they are also balsamic and emollient, softening and enriching the sharp and vapid blood, and healing the erosions occasioned thereby in the blood vessels and glands.

53. Tar water possesseth the stomachic and cardiac qualities of elixir proprietatis, Stoughton's drops, and many such tinctures and extracts, with this difference, that it worketh its effects more safely, as it hath nothing of that spirit of wine, which, however mixed and disguised, may yet be well accounted a poison in some degree.

54. Such medicines are supposed to be diaphoretic, which being of an active and subtile nature, pass through the whole system, and work their effect in the finest capillaries and perspiratory ducts, which they gently cleanse and open. Tar water is extremely well fitted to work by such an insensible diaphoresis, by the fineness and activity of its acid volatile spirit. And surely those parts ought to be very fine, which can scour the perspiratory ducts, under the scarf skin or cuticle, if it be true that one grain of sand would cover the mouths of more than a hundred thousand.

55. Another way wherein tar water operates is by urine, than which perhaps none is more safe and effectual for cleansing the blood and carrying off its salts. But it seems to produce its principal effects as an alterative, sure and easy, much safer than those vehement, purgative, emetic, and salivating medicines, which do violence to nature.

56. An obstruction of some vessels causeth the blood to move more swiftly in other vessels, which are not obstructed. Hence manifold disorders. A liquor that dilutes and attenuates resolves

the concretions which obstruct. Tar water is such a liquor. It may be said, indeed, of common water, that it attenuates, also of mercurial preparations that they attenuate. But it should be considered that mere water only distends the vessels, and thereby weakens their tone; and that mercury by its great *momentum* may justly be suspected of hurting the fine capillaries, which two deobstruents therefore might easily overact their parts, and (by lessening the force of the elastic vessels) remotely produce those concretions they are intended to remove.

57. Weak and rigid fibres are looked on by the most able physicians, as sources of two different classes of distempers: a sluggish motion of the liquids occasions weak fibres: therefore tar water is good to strengthen them as it gently accelerates their contents. On the other hand, being an unctuous bland fluid it moistens and softens the dry and stiff fibres: and so proves a remedy for both extremes.

58. Common soaps are compositions of lixivial salt and oil. The corrosive acrimony of the saline particle being softened by the mixture of an unctuous substance, they insinuate themselves into the small ducts with less difficulty and danger. The combination of these different substances makes up a very subtile and active medicine, fitted for mixing with all humours, and resolving all obstructions. Soap therefore is justly esteemed a most efficacious medicine in many distempers. Alkaline soap is allowed to be cleansing, attenuating, opening, resolving, sweetening; it is pectoral, vulnerary, diuretic, and hath other good qualities which are also to be found in tar water. It is granted, that oil and acids salts combined together exist in vegetables, and that consequently there are acid soaps as well as alkaline. And the saponaceous nature of the acid vegetable spirits, is what renders them so diuretic, sudorific, penetrating, abstersive, and resolving. Such, for instance, is the acid spirit of guaiacum. And all these same virtues seem to be in tar water in a mild and salutary degree.

59. It is the general opinion that all acids coagulate the blood. Boerhaave excepts vinegar which he holds to be a soap, inasmuch as it is found to contain an oil as well as an acid spirit. Hence it is both unctuous and penetrating, a powerful antiphlogistic, and preservative against corruption and infection. Now it seems evident that tar water is a soap as well as vinegar. For though it be the character of resin, which is an inspissated gross oil, not to dissolve in water,* yet the salts attract some fine particles of essential oil: which fine oil serves as a vehicle for the acid salts, and shows itself in the colour of the tar water: for all pure salts are colourless. And though the resin will not dissolve in

* Sect. 47.

water, yet the subtile oil, in which the vegetable salts are lodged, may as well mix with water as vinegar doth, which contains both oil and salt. And as the oil in tar water discovers itself to the eye, so the acid salts do manifest themselves to the taste. Tar water therefore is a soap, and as such hath the medicinal qualities of soaps.

60. It operates more gently as the acid salts lose their acrimony being sheathed in oil, and thereby approaching the nature of neutral salts, are more benign and friendly to the animal system: and more effectually, as by the help of a volatile smooth insinuating oil, those same salts are more easily introduced into the capillary ducts. Therefore in fevers and epidemical distempers it is (and I have found it so) as well as in chronical diseases, a most safe and efficacious medicine, being good against too great fluidity as a balsamic, and good against viscidity as a soap. There is something in the fiery corrosive nature of lixivial salts, which make alkaline soap a dangerous remedy in all cases where an inflammation is apprehended. And as inflammations are often occasioned by obstructions, it should seem an acid soap was much the safer deobstruent.

61. Even the best turpentines, however famous for their vulnerary and detergent qualities, have yet been observed by their warmth to dispose to inflammatory tumours. But the acid spirit* being in so great proportion in tar water renders it a cooler and safer medicine. And the etherial oil of turpentine, though an admirable dryer, healer, and anodyne, when outwardly applied to wounds and ulcers, and not less useful in cleansing the urinary passages and healing their ulcerations, yet is known to be of a nature so very relaxing as sometimes to do much mischief when taken inwardly. Tar water is not attended with the same ill effects, which I believe are owing in a great measure to the etherial oils being deprived of the acid spirit in distillation, which vellicating and contracting as a stimulus might have proved a counterpoise to the excessive lubricating and relaxing qualities of the oil.

62. Woods in decoction do not seem to yield so ripe and elaborate a juice, as that which is deposited in the cells or *loculi terebinthiaci*, and spontaneously oozes from them. And indeed though the balsam of Peru obtained by boiling wood and scumming the decoction, be a very valuable medicine and of great account in divers cases, particularly asthmas, nephritic pains, nervous colics and obstructions, yet I do verily think (and I do not say this without experience), that tar water is a more efficacious remedy in all those cases than even that costly drug.

63. It hath been already observed, that the restorative pectoral

* Sect. 7, 8.

antihysterical virtues of the most precious balsams and gums are possessed in a high degree by tar water.* And I do not know any purpose answered by the wood drinks, for which tar water may not be used with at least equal success. It contains the virtues of guaiacum which seems the most efficacious of all the woods, warming and sweetening the humours, diaphoretic and useful in gouts, dropsies and rheums, as well as in the foul disease. Nor should it seem strange, if the virtues obtained by boiling an old dry wood prove inferior to those extracted from a balsam.

64. There is a fine volatile spirit in the waters of Geronster, the most esteemed of all the fountains about Spa, but whose waters do not bear transporting. The stomachic, cardiac, and diuretic qualities of this fountain somewhat resemble those of tar water, which, if I am not greatly mistaken, contains the virtues of the best chalybeate and sulphureous waters; with this difference, that those waters are apt to affect the head in taking, which tar water is not. Besides, there is a regimen of diet to be observed, especially with chalybeate waters, which I never found necessary with this. Tar water layeth under no restraint either as to diet, hours, or employment. A man may study and exercise or repose, keep his own hours, pass his time either within or without, and take wholesome nourishment of any kind.

65. The use of mineral waters, however excellent for the nerves and stomach, is often suspended by cold and inflammatory disorders, in which they are acknowledged to be very dangerous; whereas tar water is so far from hurting in those cases, or being discontinued on that account, that it greatly contributes to their cure.†

66. Cordials, vulgarly so called, act immediately on the stomach, and by consent of nerves on the head. But medicines of an operation too fine and light to produce a sensible effect in the *primæ viæ*, may, nevertheless, in their passage through the capillaries, operate on the sides of those small vessels, in such manner as to quicken their oscillations, and consequently the motion of their contents, producing in issue and effect all the benefits of a cordial much more lasting and salutary than those of distilled spirits, which by their caustic and coagulating qualities do incomparably more mischief than good. Such a cardiac medicine is tar water. The transient fits of mirth, produced from fermented liquors, and distilled spirits, are attended with proportionable depressions of spirits in their intervals. But the calm cheerfulness arising from this water of health (as it may be justly called) is permanent; in which it emulates the virtues of that famous plant Gen Seng, so much valued in China as the only cordial that raises the spirits without depressing them. Tar

* Sect. 9, 21, 22, 23. † Sect. 7.

water is so far from hurting the nerves as common cordials do, that it is highly useful in cramps, spasms of the viscera, and paralytic numbness.

67. Emetics are on certain occasions administered with great success. But the overstraining and weakening of nature may be very justly apprehended from a course of emetics. They are nevertheless prescribed and substituted for exercise. But it is well remarked in Plato's Timæus that vomits and purges are the worse exercise in the world. There is something in the mild operation of tar water, that seems more friendly to the economy, and forwards the digestions and secretions in a way more natural and benign, the mildness of this medicine being such that I have known children take it, for above six months together, with great benefit, and without any inconvenience; and after long and repeated experience I do esteem it a most excellent diet drink fitted to all seasons and ages.

68. It is I think allowed that the origin of the gout lies in a faulty digestion. And it is remarked by the ablest physicians, that the gout is so difficult to cure, because heating medicines aggravate its immediate, and cooling its remote cause. But tar water, although it contains active principles that strengthen the digestion beyond any thing I know, and consequently must be highly useful, either to prevent or lessen the following fit, or by invigorating the blood to cast it upon the extremities, yet it is not of so heating a nature as to do harm even in the fit. Nothing is more difficult or disagreeable than to argue men out of their prejudices, I shall not therefore enter into controversies on this subject, but if men dispute and object, shall leave the decision to time and trial.

69. In the modern practice, soap, opium, and mercury bid fairest for universal medicines. The first of these is highly spoken of. But then those who magnify it most, except against the use of it in such cases where the obstruction is attended with a putrefactive alkali, or where an inflammatory disposition appears. It is acknowledged to be very dangerous in a pthisis, fever, and some other cases in which tar water is not only safe but useful.

70. Opium, though a medicine of great extent and efficacy, yet is frequently known to produce grievous disorders in hysterical or hypochrondriacal persons, who make a great part, perhaps the greatest of those who lead sedentary lives in these islands. Besides, upon all constitutions dangerous errors may be committed in the use of opium.

71. Mercury hath of late years become a medicine of very general use. The extreme minuteness, mobility, and momentum of its parts, rendering it a most powerful cleanser of all obstructions, even in the most minute capillaries. But then we should

be cautious in the use of it, if we consider, that the very thing which gives it power of doing good above other deobstruents, doth also dispose it to do mischief: I mean its great momentum, the weight of it being about ten times that of blood, and the momentum being the joint product of the weight and velocity, it must needs operate with great force; and may it not be justly feared, that so great a force entering the minutest vessels, and breaking the obstructed matter, might also break or wound the fine tender coats of those small vessels, and so bring on the untimely effects of old age, producing more, perhaps, and worse obstructions than those it removed? Similar consequences may justly be apprehended from other mineral and ponderous medicines. Therefore upon the whole, there will not perhaps be found any medicine more general in its use, or more salutary in its effects than tar water.

72. To suppose that all distempers arising from very different, and it may be from contrary causes, can be cured by one and the same medicine, must seem chimerical. But it may with truth be affirmed, that the virtue of tar water extends to a surprising variety of cases very distant and unlike.* This I have experienced in my neighbours, my family, and myself. And as I live in a remote corner among poor neighbours, who for want of a regular physician have often recourse to me, I have had frequent opportunities of trial, which convince me it is of so just a temperament as to be an enemy to all extremes. I have known it do great good in a cold watery constitution, as a cardiac and stomachic: and at the same time allay heat and feverish thirst in another. I have known it correct costive habits in some, and the contrary habit in others. Nor will this seem incredible if it be considered, that middle qualities naturally reduce the extreme. Warm water, for instance, mixed with hot and cold, will lessen the heat in that, and the cold in this.

73. They who know the great virtues of common soap, whose coarse lixivial salts are the product of culinary fire, will not think it incredible that virtues of mighty force and extent should be found in a fine acid soap,† the salts and oil whereof are a most elaborate product of nature and the solar light.

74. It is certain tar-water warms, and therefore some may perhaps still think it cannot cool. The more effectually to remove this prejudice, let it be further considered, that as on the one hand, opposite causes do sometimes produce the same effect; for instance, heat by rarefaction and cold by condensation do both increase the air's elasticity; so on the other hand, the same cause shall sometimes produce opposite effects; heat, for instance, thins, and again heat coagulates the blood. It is not therefore strange, that tar water should warm one habit and cool another,

* Sect. 3, 4, 5, 6, 21, &c. † Sect. 58.

have one good effect on a cold constitution, and another good effect on an inflamed one; nor, if this be so, that it should cure opposite disorders. All which justifies to reason what I have often found true in fact. The salts, the spirits, the heat of tar water, are of a temperature congenial to the constitution of a man which receives from it a kindly warmth, but no inflaming heat. It was remarkable that two children in my neighbourhood, being in a course of tar water, upon an intermission of it, never failed to have their issues inflamed by a humour much more hot and sharp than at other times. But its great use in the small pox, pleurisies, and fevers, is a sufficient proof that tar water is not of an inflaming nature.

75. I have dwelt the longer on this head, because some gentlemen of the faculty have thought fit to declare that tar water must inflame, and that they would never visit any patient in a fever who had been a drinker of it. But I will venture to affirm, that it is so far from increasing a feverish inflammation, that it is on the contrary a most ready means to allay and extinguish it. It is of admirable use in fevers, being at the same time the surest, safest, and most effectual, both paregoric and cordial; for the truth of which I appeal to any person's experience who shall take a large draught of it milk warm in the paroxysm of a fever, even when plain water or herb teas shall be found to have little or no effect. To me it seems that its singular and surprising use in fevers of all kinds, were there nothing else, would be alone sufficient to recommend it to the public.

76. The best physicians make the idea of a fever to consist in a too great velocity of the heart's motion, and too great resistance at the capillaries. Tar water, as it softens and gently stimulates those nice vessels, helps to propel their contents, and so contributes to remove the latter part of the disorder. And for the former, the irritating acrimony which accelerates the motion of the heart is diluted by watery, corrected by acid, and softened by balsamic remedies, all which intentions are answered by this aqueous acid balsamic medicine. Besides, the viscid juices coagulated by the febrile heat are resolved by tar water as a soap, and not too far resolved, as it is a gentle acid soap; to which we may add, that the peccant humours and salts are carried off by its diaphoretic and diuretic qualities.

77. I found all this confirmed by my own experience in the late sickly season of the year one thousand seven hundred and forty-one, having had twenty-five fevers in my own family cured by this medicinal water, drunk copiously. The same method was practised on several of my poor neighbours with equal success. It suddenly calmed the feverish anxieties, and every glass seemed to refresh, and infuse life and spirit into the patient. At first, some of those patients had been vomited, but afterwards I found

that without vomiting, bleeding, blistering, or any other evacuation or medicine whatever, very bad fevers could be cured by the sole drinking of tar water milk warm, and in good quantity, perhaps a large glass every hour, or oftener, taken in bed. And it was remarkable, that such as were cured by this comfortable cordial, recovered health and spirits at once, while those who had been cured by evacuations often languished long, even after the fever had left them, before they could recover of their medicines, and regain their strength.

78. In peripneumonies and pleurisies I have observed tar water to be excellent, having known some pleuritic persons cured without bleeding, by a blister early applied to the stitch, and the copious drinking of tar water, four or five quarts, or even more, in four and twenty hours. And I do recommend it to further trial, whether in all cases of a pleurisy, one moderate bleeding, a blister on the spot, and plenty of tepid tar water may not suffice, without those repeated and immoderate bleedings, the bad effects of which are perhaps never got over. I do even suspect that a pleuritic patient betaking himself to bed betimes, and drinking very copiously of tar water, may be cured by that alone without bleeding, blistering, or any other medicine whatsoever, certainly I have found this succeed at a glass every half hour.

79. I have known a bloody flux of long continuance, after divers medicines had been tried in vain, cured by tar water. But that which I take to be the most speedy and effectual remedy in a bloody flux, is a clyster of an ounce of common brown resin dissolved over a fire in two ounces of oil, and added to a pint of broth, which not long since I had frequent occasion of trying when that distemper was epidemical. Nor can I say that any to whom I advised it miscarried. This experiment I was led to make by the opinion I had of tar as a balsamic; and resin is only tar inspissated.

80. Nothing that I know corroborates the stomach so much as tar water.* Whence it follows, that it must be of singular use to persons afflicted with the gout. And from what I have observed in five or six instances, I do verily believe it the best and safest medicine either to prevent the gout, or so to strengthen nature against the fit, as to drive it from the vitals. Dr. Sydenham, in his treatise on the gout, declares, that whoever finds a medicine the most efficacious for strengthening digestion, will do more service in the cure of that and other chronical distempers, than he can even form a notion of. And I leave it to trial whether tar water be not that medicine, as I myself am persuaded it is, by all the experiments I could make. But in all trials I would recommend discretion; for instance, a man with the gout ought not to drink cold tar water. This essay

* Sect. 68.

leaves room for future experiment in every part of it, not pretending to be a complete treatise.

81. It is evident to sense, that blood, urine, and other animal juices, being let to stand, soon contract a great acrimony. Juices, therefore from a bad digestion, retained and stagnating in the body, grow sharp and putrid. Hence a fermenting heat, the immediate cause of the gout. The curing this by cooling medicines, as they would increase the antecedent cause, must be a vain attempt. On the other hand, spices and spirituous liquors, while they contribute to remove the antecedent cause, or bad digestion, would by inflaming the blood increase the proximate or immediate cause of the gout, to wit, the fermenting heat. The scope therefore must be, to find a medicine that shall corroborate, but not inflame. Bitter herbs are recommended; but they are weak in comparison of tar water.

82. The great force of tar water, to correct the acrimony of the blood, appears in nothing more than in the cure of a gangrene from an internal cause; which was performed on a servant of my own, by prescribing the copious and constant use of tar water for a few weeks. From my representing tar water as good for so many things, some perhaps may conclude it is good for nothing. But charity obligeth me to say, what I know, and what I think, howsoever it may be taken. Men may censure and object as they please, but I appeal to time and experiment. Effects misimputed, cases wrong told, circumstances overlooked, perhaps too, prejudices and partialities against truth, may for a time prevail and keep her at the bottom of her well, from whence nevertheless she emergeth sooner or later, and strikes the eyes of all who do not keep them shut.

83. Boerhaave thinks a specific may be found for that peculiar venom which infects the blood in the small pox, and that the prospect of so great a public benefit should stir up men to search for it. Its wonderful success in preventing and mitigating that distemper,* would incline one to suspect that tar water is such a specific, especially since I have found it of sovereign use as well during the small pox as before it. Some think an erysipelas and the plague differ only in degree. If so, tar water should be useful in the plague, for I have known it cure an erysipelas.

84. Tar water, as cleansing, healing, and balsamic, is good in all disorders of the urinary passages, whether obstructed or ulcerated. Dr. Lister supposeth, indeed, that turpentines act by a caustic quality, which irritates the coats of the urinary ducts to expel sand or gravel. But it should seem this expelling diuretic virtue, consisted rather in the salts than the resin, and consequently resides in the tar water, gently stimulating by its

* Sect. 2, 3.

salts, without the dangerous force of a caustic. The violent operation of ipecacuanha lies in its resin, but the saline extract is a gentle purge and diuretic, by the stimulus of its salts.

85. That which acts as a mild cordial,* neither hurting the capillary vessels as a caustic, nor affecting the nerves, nor coagulating the juices, must in all cases be a friend to nature, and assist the *vis vitæ* in its struggle against all kinds of contagion. And from what I have observed, tar water appears to me an useful preservative in all epidemical disorders, and against all other infection whatsoever, as well as that of the small pox. What effects the *animi pathemata* have in human maladies is well known, and consequently the general benefit of such a cardiac may be reasonably supposed.

86. As the body is said to clothe the soul, so the nerves may be said to constitute her inner garment. And as the soul animates the whole, what nearly touches the soul relates to all. Therefore the asperity of tartarous salts, and the fiery acrimony of alkaline salts, irritating and wounding the nerves, produce nascent passions and anxieties in the soul; which both aggravate distempers, and render men's lives restless and wretched, even when they are afflicted with no apparent distemper. This is the latent spring of much woe, spleen, and *tædium vitæ*. Small imperceptible irritations of the minutest fibres or filaments caused by the pungent salts of wines and sauces, do so shake and disturb the microcosms of high livers, as often to raise tempests in courts and senates. Whereas the gentle vibrations that are raised in the nerves, by a fine subtile acid, sheathed in a smooth volatile oil,† softly stimulating and bracing the nervous vessels and fibres, promotes a due circulation and secretion of the animal juices, and creates a calm satisfied sense of health. And accordingly I have often known tar water procure sleep and compose the spirits in cruel vigils, occasioned either by sickness or by too intense application of mind.

87. In diseases sometimes accidents happen from without by mismanagement, sometimes latent causes operate within, jointly with the specific taint or peculiar cause of the malady. The causes of distempers are often complicated, and there may be something in the idiosyncrasy of the patient that puzzles the physician. It may therefore be presumed that no medicine is infallible, not even in any one disorder. But as tar water possesseth the virtues of fortifying the stomach, as well as purifying and invigorating the blood, beyond any medicine that I know, it may be presumed of great and general efficacy in all those numerous illnesses, which take their rise from foul or vapid blood, or from a bad digestion. The animal spirits are elaborated from the blood. Such therefore as the blood is, such will be the ani-

* Sect. 66. † Sect. 59, 61.

mal spirit, more or less, weaker or stronger. This showeth the usefulness of tar water in all hysteric and hypochondriac cases: which together with the maladies from indigestion comprise almost the whole tribe of chronical diseases.

88. The scurvy may be reckoned in these climates an universal malady, as people in general are subject to it, and as it mixes more or less in almost all diseases. Whether this proceeds from want of elasticity in our air, upon which the tone of the vessels depends, and upon that the several secretions: or whether it proceeds from the moisture of our climate, or the grossness of our food, or the salts in our atmosphere, or from all these together. Thus much at least seems not absurd to suppose, that as physicians in Spain and Italy are apt to suspect the venereal taint to be a latent principle, and bear a part in every illness, so far as good reason the scurvy should be considered by our physicians as having some share in most disorders and constitutions that fall in their way. It is certain our perspiration is not so free as in clearer air and warmer climates. Perspirable humours not discharged will stagnate and putrify. A diet of animal food will be apt to render the juices of our bodies alkalescent. Hence ichorous and corrosive humours and many disorders. Moist air makes viscid blood; and saline air inflames this viscid blood. Hence broken capillaries, extravasated blood, spots and ulcers, and other scorbutic symptoms. The body of a man attracts and imbibes the moisture and salts of the air, and whatever floats in the atmosphere, which as it is common to all, so it affects all more or less.

89. Dr. Musgrove thinks the Devonshire scurvy a relic of the leprosy, and that it is not owing to the qualities of the air; but as these insulars in general live in a gross saline air, and their vessels being less elastic, are consequently less able to subdue and cast off what their bodies as sponges draw in, one would be tempted to suspect the air not a little concerned, especially in such a situation as that of Devonshire. In all these British islands we enjoy a great mediocrity of climate, the effect whereof is, that we have neither heat enough to exalt and dissipate the gross vapours, as in Italy, nor cold enough to condense and precipitate them, as in Sweden. So they are left floating in the air, which we constantly breathe and imbibe through the whole surface of our bodies. And this together with the exhalations from coal fires, and the various fossils wherein we abound, doth greatly contribute to render us scorbutic and hypochondriac.

90. There are some who derive all diseases from the scurvy, which indeed must be allowed to create or mimic most other maladies. Boerhaave tells us, it produceth pleuritic, colic, nephritic, hepatic pains, various fevers, hot, malignant, intermitting dysenteries, faintings, anxieties, dropsies, consumptions, convulsions, palsies, fluxes of blood. In a word, it may be said to contain the seeds

and origin of almost all distempers. Insomuch that a medicine which cures all sorts of scurvy, may be presumed good for most other maladies.

91. The scurvy doth not only in variety of symptoms imitate most distempers, but also, when come to a height, in degree of virulence equals the most malignant. Of this we have a remarkable proof, in that horrible description of the scorbutic patients in the hospitals of Paris, given by M. Poupart, in the memoirs of the royal academy of sciences, for the year one thousand six hundred and ninety-nine. That author thinks he saw some resemblance in it to the plague of Athens. It is hard to imagine any thing more dreadful than the case of those men, rotting alive by the scurvy in its supreme degree. To obviate such putrefaction, I believe the most effectual method would be, to embalm (if one may so say) the living body with tar water copiously drunk; and this belief is not without experience.

92. It is the received opinion, that the animal salts of a sound body are of a neutral, bland, and benign nature: that is, the salts in the juices past the *primæ viæ*, are neither acid nor alkaline, having been subdued by the constitution, and changed into a third nature. Where the constitution wants force to do this, the aliment is not duly assimilated; and so far as the salts retain their pristine qualities, sickly symptoms ensue, acids and alkalies, not perfectly subdued, producing weak ferments in the juices. Hence scurvy, cachexy, and a long train of ills.

93. A cachexy or ill habit is much of the same kind with the scurvy, proceeds from the same causes, and is attended with like symptoms, which are so manifold and various, that the scurvy may well be looked on as a general cachexy, infecting the whole habit and vitiating all the digestions. Some have reckoned as many sorts of the scurvy as there are different taints of the blood. Others have supposed it a collection of all illnesses together. Some suppose it an accumulation of several diseases *in fieri*. Others take it for an assemblage of the relics of old distempers.

94. But thus much is certain, the cure of the scurvy is no more to be attempted by strongly active medicines than (to use the similitude of an ingenious writer) a thorn in the flesh, or pitch on silk, to be removed by force. The viscid humour must be gently resolved and diluted, the tone of the vessels recovered by a moderate stimulation, and the tender fibres and capillary vessels gradually cleared from the concreted stuff that adheres and obstructs them. All which is in the aptest manner performed by a watery diluent, containing a fine vegetable soap. And although a complete cure by alteratives, operating on the small capillaries and by insensible discharges, must require length of time, yet the good effect of this medicine on cachectic and scorbutic persons is soon perceived, by the change it pro-

duceth in their pale, discoloured looks, giving a florid, healthy countenance in less time than perhaps any other medicine.

95. It is supposed by physicians, that the immediate cause of the scurvy lies in the blood, the fibrous part of which is too thick, and the serum too thin and sharp; and that hence ariseth the great difficulty in the cure, because in the correcting of one part regard must be had to the other. It is well known, how extremely difficult it is to cure an inveterate scurvy: how many scorbutic patients have grown worse by an injudicious course of evacuations; how many are even rendered incurable by the treatment of inconsiderate physicians; and how difficult, tedious, and uncertain the cure is in the hands even of the best, who are obliged to use such variety and change of medicines in the different stages of that malady: which nevertheless may be cured (if I may judge by what I have experienced) by the sole, regular, constant, copious use of tar water.

96. Tar water moderately inspissates with its balsamic virtue, and renders mild the thin and sharp part of the blood. The same, as a soapy medicine, dissolves the grumous concretions of the fibrous part. As a balsam it destroys the ulcerous acrimony of the humours, and as a deobstruent it opens and cleans the vessels, restores their tone, and strengthens the digestion, whose defects are the principal cause of scurvy and cachexy.

97. In the cure of the scurvy, the principal aim is to subdue the acrimony of the blood and juices. But as this acrimony proceeds from different causes, or even opposite, as acid and alkaline, what is good in one sort of scurvy proves dangerous, or even mortal, in another. It is well known, that hot antiscorbutics, where the juices of the body are alkalescent, increase the disease. And sour fruits and vegetables produce a like effect in the scurvy caused by an acid acrimony. Hence fatal blunders are committed by unwary practitioners, who, not distinguishing the nature of the disease, do frequently aggravate, instead of curing it. If I may trust what trials I have been able to make, this water is good in the several kinds of scurvy, acid, alkaline, and muriatic; and I believe it the only medicine that cures them all, without doing hurt to any. As it contains a volatile acid* with a fine volatile oil, why may not a medicine cool in one part and warm in another, be a remedy to either extreme?† I have observed it to produce a kindly, genial warmth, without heat, a thing to be aimed at in all sorts of scurvy. Besides, the balsam in tar water sheaths all scorbutic salts alike: and its great virtues as a digester and deobstruent are of general use in all scorbutic, and I may add, in all chronical cases whatsoever.

98. I cannot be sure that I have tried it in a scrofulous case, though I have tried it successfully in one that I suspected to be

* Sect. 7. † Sect. 72.

so. And I apprehend it would be very serviceable in such disorders. For although Dr. Gibbs, in his treatise on the king's evil, derives that disease from a coagulating acid, which is also agreeable to the opinion of some other physicians, and although tar water contains an acid, yet as it is a soap,* it resolves instead of coagulating the juices of the body.

99. For hysterical and hypochondriacal disorders so frequent among us, it is commonly supposed that all acids are bad. But I will venture to except the acid soap of tar water, having found by my own experience and that of many others, that it raises the spirits, and is an excellent anti-hysteric, nor less innocent than potent, which cannot be said of those others in common use, that often leave people worse than they found them.

100. In a high degree of scurvy a mercurial salivation is looked on by many as the only cure. Which by the vehement shock it gives the whole frame, and the sensible secretion it produceth, may be thought more adequate to such an effect. But the disorder occasioned by that violent process, it is to be feared, may never be got over. The immediate danger, the frequent bad effects, the extreme trouble and nice care attending such a course, do very deservedly make people afraid of it. And though the sensible secretion therein be so great, yet in a longer tract of time the use of tar water may produce as great a discharge of scorbutic salts by urine and by perspiration, the effect of which last, though not so sensible, may yet be greater than that of salivation; especially if it be true, that in common life insensible perspiration is to nutrition, and all sensible excretions as five to three.

101. Many hysteric and scorbutic ailments, many taints contracted by themselves, or inherited from their ancestors, afflict the people of condition in these islands, often rendering them, upon the whole, much more unhappy than those whom poverty and labour have ranked in the lowest lot of life; which ailments might be safely removed or relieved by the sole use of tar water: and those lives which seem hardly worth living for, bad appetite, low spirits, restless nights, wasting pains and anxieties, be rendered easy and comfortable.

102. As the nerves are instruments of sensation, it follows that spasms in the nerves may produce all symptoms, and therefore a disorder in the nervous system shall imitate all distempers, and occasion, in appearance, an asthma for instance, a pleurisy, or a fit of the stone. Now whatever is good for the nerves in general is good against all such symptoms. But tar water, as it includes in an eminent degree the virtues of warm gums and resins, is of great use for comforting and strengthening the nerves,† curing twitches in the nervous fibres, cramps also, and numbness in the

* Sect. 58. † Sect. 86.

limbs, removing anxieties and promoting sleep, in all which cases I have known it very successful.

103. This safe and cheap medicine suits all circumstances and all constitutions, operating easily, curing without disturbing, raising the spirits without depressing them, a circumstance that deserves repeated attention, especially in these climates, where strong liquors so fatally and so frequently produce those very distresses they are designed to remedy; and, if I am not misinformed, even among the ladies themselves, who are truly much to pitied. Their condition of life makes them a prey to imaginary woes, which never fail to grow up in minds unexercised and unemployed. To get rid of these, it is said, there are, who betake themselves to distilled spirits. And it is not improbable, they are led gradually to the use of those poisons by a certain complaisant pharmacy, too much used in the modern practice, palsy drops, poppy cordial, plague-water, and such like, which being in truth nothing but drams disguised, yet coming from the apothecaries, are considered only as medicines.

104. The soul of man was supposed by many ancient sages, to be thrust into the human body as into a prison, for punishment of past offences. But the worst prison is the body of an indolent epicure, whose blood is inflamed by fermented liquors * and high sauces, are rendered putrid, sharp, and corrosive, by a stagnation of the animal juices through sloth and indolence; whose membranes are irritated by pungent salts; whose mind is agitated by painful oscillations of the nervous † system, and whose nerves are mutually affected by the irregular passions of his mind. This ferment in the animal economy darkens and confounds the intellect. It produceth vain terrors and vain conceits, and stimulates the soul with mad desires, which, not being natural, nothing in nature can satisfy. No wonder, therefore, there are so many fine persons of both sexes, shining themselves, and shone on by fortune, who are inwardly miserable and sick of life.

105. The hardness of stubbed vulgar constitutions, renders them insensible of a thousand things that fret and gall those delicate people, who, as if their skin was peeled off, feel to the quick every thing that touches them. The remedy for this exquisite and painful sensibility is commonly sought from fermented, perhaps from distilled liquors, which render many lives wretched that would otherwise have been only ridiculous. The tender nerves and low spirits of such poor creatures, would be much relieved by the use of tar water, which might prolong and cheer their lives. I do therefore recommend to them the use of a cordial, not only safe and innocent, but giving health and spirit as surely as other cordials destroy them.

106. I do verily think, there is not any other medicine whatso-

* Sect. 66. † Sect. 86.

ever, so effectual to restore a crazy constitution, and cheer a dreary mind, or so likely to subvert that gloomy empire of the spleen * which tyranniseth over the better sort (as they are called) of these free nations; and maketh them, in spite of their liberty and property, more wretched slaves than even the subjects of absolute power, who breathe clear air in a sunny climate: while men of low degree often enjoy a tranquillity and content, that no advantage of birth or fortune can equal. Such, indeed, was the case, while the rich alone could afford to be debauched; but when even beggars became debauchees, the case was altered.

107. The public virtue and spirit of the British legislature never showed itself more conspicuous in any act, than in that for suppressing the immoderate use of distilled spirits among the people, whose strength and numbers constitute the true wealth of a nation; though evasive arts will, it is feared, prevail so long as distilled spirits of any kind are allowed, the character of Englishmen in general, being that of Brutus, *Quicquid vult valde vult.* But why should such a canker be tolerated in the vitals of a state under any pretence or in any shape whatsoever? Better by far, the whole present set of distillers were pensioners of the public, and their trade abolished by law; since all the benefit thereof put together would not balance the hundredth part of its mischief.

108. To prove the destructive effects of such spirits with regard both to the human species and individuals, we need not go so far as our colonies, or the savage natives of America. Plain proof may be had nearer home. For, albeit, there is in every town or district throughout England, some tough dram-drinker, set up as the devil's decoy, to draw in proselytes; yet the ruined health and morals, and the beggary of such numbers evidently show that we need no other enemy to complete our destruction, than this cheap luxury at the lower end of the state, and that a nation lighted up at both ends must soon be consumed.

109. It is much to be lamented that our insulars, who act and think so much for themselves, should yet from grossness of air and diet, grow stupid or doat sooner than other people, who by virtue of elastic air, water-drinking, and light food, preserve their faculties to extreme old age; an advantage which may perhaps be approached, if not equalled, even in these regions by tar water, temperance, and early hours; the last is a sure addition to life, not only in regard of time, which, being taken from sleep, the image of death, is added to the waking hours, but also in regard of longevity and duration in the vulgar sense. I may say too, in regard of spirit and vivacity, which, within the same compass of duration, may, truly and properly be affirmed to add to man's life: it being manifest, that one man, by a brisker motion of his spirits, and succession of his ideas, shall live more in one hour

* Sect. 103.

than another in two: and that the quantity of life is to be estimated, not merely from the duration, but also from the intenseness of living. Which intense living, or, if I may so say, lively life, is not more promoted by early hours as a regimen, than by tar water as a cordial; which acts, not only as a slow medicine, but hath also an immediate and cheerful * effect on the spirits.

110. It must be owned, the light attracted, secreted, and detained in tar,† and afterwards drawn off in its finest balsamic particles, by the gentle menstruum of cold water, is not a violent and sudden medicine, always to produce its effect at once (such by irritating, often do more mischief than good) but a safe and mild alterative, which penetrates the whole system, opens, heals, and strengthens, the remote vessels, alters and propels their contents, and enters the minutest capillaries, and cannot, therefore, otherwise than by degrees and in time, work a radical cure of chronic distempers. It gives, nevertheless, speedy relief in most cases, as I have found by myself and many others. I have been surprised to see persons fallen away and languishing under a bad digestion, after a few weeks recover a good stomach, and with it flesh and strength, so as to seem renewed, by the drinking of tar water. The strength and quantity of this water to be taken by each individual person, is best determined from experience. And as for the time of taking, I never knew any evil ensue from its being continued ever so long; but, on the contrary, many and great advantages, which sometimes would not perhaps begin to show themselves till it had been taken two or three months.

111. We learn from Pliny, that in the first ferment of new wine or mustum, the ancients were wont to sprinkle it with powdered resin, which gave it a certain sprightliness, *quædam saporis acumina.* This was esteemed a great improver of its odour and taste; and was, I doubt not, of its salubrity also. The brown old resin, that is to say, hardened tar, as being more easily pulverized and sifted, was most in request for this purpose. They used likewise to season their wine vessels with pitch or resin. And, I make no doubt, that if our vintners would contrive to medicate their wines with the same ingredients, they might improve and preserve them, with less trouble and expense to themselves, and less danger to others. He that would know more particulars of this matter may consult Pliny and Columella. I shall only add, that I doubt not a similar improvement may be made of malt liquor.

112. The ῥητίνη of Theophrastus and resina of Pliny are sometimes used in a general sense, to signify all sorts of oily viscid exsudations from plants or trees. The crude watery juice, that riseth early in the spring, is gradually ripened and inspis-

* Sect. 66. † Sect. 8, 29, 40.

sated by the solar heat, becoming in orderly succession with the seasons an oil, a balsam, and at last a resin. And it is observed by chymists, that turpentine, dissolved over a gentle fire, is, by the constant operation of heat, successively transformed into oil, balsam, pitch, and hard friable resin, which will incorporate with oil or rectified spirit, but not with water.

113. Sir John Floyer remarks, that we want a method for the use of turpentine; and again, he who shall hit, saith he, on the pleasantest method of giving turpentine, will do great cures in the gout, stone, catarrhs, dropsies, and cold scurvies, rheumatisms, ulcers, and obstructions of the glands. Lastly, he subjoins, that for the use of altering and amending the juices and fibres, it must be given frequently, and in such small quantities at a time, and in so commodious a manner, as will agree best with the stomach,* stay longest in the body, and not purge itself off; for large doses (saith he) go through too quick, and besides offend the head. Now the infusion of tar or turpentine in cold water, seems to supply the very method that was wanted, as it leaves the more unctuous and gross parts behind,† which might offend the stomach, intestines, and head; and as it may be easily taken, and as often, and in such quantity and such degree of strength, as suits the case of the patient; nor should it seem, that the fine spirit and volatile oil, obtained by infusion of tar,‡ is inferior to that of turpentine, to which it superadds the virtue of wood soot, which is known to be very great with respect to the head and nerves; and this appears evident from the manner of obtaining tar.§ And as the fine volatile parts of tar or turpentine are drawn off by infusion in cold water, and easily conveyed throughout the whole system of the human body; so it should seem the same method may be used with all sorts of balsams or resins whatsoever, as the readiest, easiest, and most inoffensive, as well as in many cases the most effectual way, of obtaining and imparting their virtues.

114. After having said so much of the uses of tar, I must further add, that being rubbed on them, it is an excellent preservative of the teeth and gums: that it sweetens the breath, and that it clears and strengthens the voice. And, as its effects are various and useful, so there is nothing to be feared from the operation of an alternative so mild and friendly to nature. It was a wise maxim of certain ancient philosophers, that diseases ought not to be irritated by medicines.‖ But no medicine disturbs the animal economy less than this, which, if I may trust my own experience, never produces any disorder in a patient when rightly taken.

115. I knew indeed a person who took a large glass of tar

* Sect. 9. † Sect. 47. ‡ Sect. 7, 42, 58. § Sect. 13. ‖ Sect. 103.

water just before breakfast, which gave him an invincible nausea and disgust, although he had before received the greatest benefit from it. But if the tar water be taken and made in the manner prescribed at the beginning of this essay, it will, if I mistake not, have enough of the salt to be useful, and little enough of the oil to be inoffensive. I mean my own manner of making it, and not the American, which makes it sometimes too strong and sometimes too weak, and however serviceable as there used, merely for a preservative against the small-pox, yet may not be fit to use in all those various cases wherein I have found tar water so successful. Persons more delicate than ordinary, may render it palatable by mixing a drop of the chemical oil of nutmegs, or a spoonful of mountain wine in each glass. It may not be amiss to observe, that I have known some, whose nice stomachs could not bear it in the morning, take it at night going to bed without any inconvenience. For outward washes and fomentations, it may be made stronger as by pouring on warm water; also for brute beasts, as horses, in whose disorders I have found it very useful, I believe more so than that bituminous substance called Barbadoes tar.

116. In very dangerous and acute cases much may be taken and often; as far as the stomach can bear. But in chronical cases, about half a pint night and morning may suffice, or, in case so large a dose should prove disagreeable, half the quantity may be taken four times, to wit, in the morning early, at night going to bed, and about two hours after dinner and breakfast. A medicine of so great virtue in so many different disorders, and especially in that grand enemy, the fever, must needs be a benefit to mankind in general. There are, nevertheless, three sorts of people to whom I would peculiarly recommend it: sea-faring persons, ladies, and men of studious and sedentary lives.

117. To sailors and all sea-faring persons, who are subject to scorbutic disorders and putrid fevers, especially in long southern voyages, I am persuaded this tar water would be very beneficial. And this may deserve particular notice in the present course of marine expeditions, when so many of our countrymen have perished by such distempers, contracted at sea and in foreign climates. Which, it is probable, might have been prevented by the copious use of tar water.

118. This same water will also give charitable relief to the ladies,* who often want it more than the parish poor; being many of them never able to make a good meal, and sitting pale, puny, and forbidden like ghosts, at their own table, victims of vapours and indigestion.

119. Studious persons also pent up in narrow holes, breathing bad air, and stooping over their books, are much to be pitied.

* Sect. 103.

As they are debarred the free use of air and exercise, this I will venture to recommend as the best succedaneum to both. Though it were to be wished that modern scholars would, like the ancients, meditate and converse more in walks and gardens and open air, which, upon the whole, would perhaps be no hindrance to their learning, and a great advantage to their health. My own sedentary course of life had long since thrown me into an ill habit, attended with many ailments, particularly a nervous colic, which rendered my life a burden, and the more so because my pains were exasperated by exercise. But since the use of tar water, I find, though not a perfect recovery from my old and rooted illness, yet such a gradual return of health and ease, that I esteem my having taken this medicine the greatest of all temporal blessings, and am convinced, that under providence, I owe my life to it.

120. In the distilling of turpentine and other balsams by a gentle heat, it hath been observed that there ariseth first an acid spirit* that will mix with water; which spirit, except the fire be very gentle, is lost. This grateful acid spirit that first comes over, is, as a learned chymist and physician informs us, highly refrigeratory, diuretic, sudorific, balsamic, or preservative from putrefaction, excellent in nephritic cases, and for quenching thirst, all which virtues are contained in the cold infusion, which draws forth from tar only its fine flower or quintessence, if I may so say, or the native vegetable spirit, together with a little volatile oil.

121. The distinguishing principle of all vegetables, that whereon their peculiar smell, taste, and specific properties depend, seems to be some extremely fine and subtile spirit, whose immediate vehicle is an exceeding thin volatile oil, which is itself detained in a grosser and more viscid resin or balsam, lodged in proper cells in the bark and seeds, and most abounding in autumn or winter, after the crude juices have been thoroughly concocted, ripened, and impregnated with solar light. The spirit itself is by some supposed to be an oil highly subtilized, so as to mix with water. But such volatile oil is not the spirit, but only its vehicle. Since aromatic oils being long exposed to air, will lose their specific smell and taste, which fly off with the spirit or vegetable salt, without any sensible diminution of the oil.

122. Those volatile salts that are set free and raised by a gentle heat, may justly be supposed essential,† and to have pre-existed in the vegetable; whereas the lixivial fixed salts obtained by the incineration of the subject, whose natural constituent parts have been altered or destroyed by the extreme force of fire, are by later chymists, upon very good grounds, supposed not to have pre-existed therein; all such salts appearing, from the expe-

* Sect. 7. † Sect. 8.

riments of signior Redi, not to preserve the virtues of the respective vegetable subjects; and to be alike purgative and in an equal degree, whatsoever may be the shape of their points, whether sharp or obtuse. But although fixed or lixivial salts may not contain the original properties of the subject; yet volatile salts raised by a slight heat from vegetables are allowed to preserve their native virtues: and such salts are readily imbibed by water.

123. The most volatile of the salts, and the most attenuated part of the oil, may be supposed the first and readiest to impregnate a cold infusion.* And this will assist us to account for the virtues of tar water. That volatile acid in vegetables, which resists putrefaction and is their great preservative, is detained in a subtile oil miscible with water, which oil is itself imprisoned in the resin or grosser part of the tar, from which it is easily set free and obtained pure by cold water.

124. The mild native acids are observed more kindly to work upon, and more thoroughly to dissolve, metallic bodies, than the strongest acid spirits produced by a vehement fire; and it may be suspected they have the same advantage as a medicine. And as no acid, by the observation of some of the best chymists, can be obtained from the substance of animals thoroughly assimilated, it should follow that the acids received into a healthy body must be quite subdued and changed by the vital powers: but it is easier to subdue and assimilate† the gentler than the stronger acids.

125. I am very sensible that on such subjects arguments fall short of evidence: and that mine fall short even of what they might have been if I enjoyed better health, or those opportunities of a learned commerce, from which I am cut off in this remote corner. I shall, nevertheless, go on as I have begun, and proceed by reason, by conjecture, and by authority, to cast the best light I can on the obscure paths that lie in my way.

125. Sir Isaac Newton, Boerhaave, and Homberg, are all agreed that the acid is a fine subtile substance, pervading the whole terraqueous globe; which produceth divers kinds of bodies, as it is united to different subjects. This, according to Homberg, is the pure salt, salt the principle, in itself similar and uniform, but never found alone. And although this principle be called the salt of the earth, yet it should seem it may more properly be called the salt of the air, since earth turned up and lying fallow receives it from the air. And it should seem that this is the great principle of vegetation, derived into the earth from all sorts of manures, as well as from the air. The acid is allowed to be the cause of fermentation in all fermented liquors. Why, therefore, may it not be supposed to ferment the earth, and to constitute that fine penetrating principle, which introduces and

* Sect. 1, 7. † Sect. 48.

assimilates the food of plants, and is so fugitive as to escape all the filtrations and perquisitions of the most nice observers?

127. It is the doctrine of Sir Isaac Newton and Monsieur Homberg, that, as the watery acid is that which renders salt soluble in water, so it is that same which joined to the earthy part makes it a salt. Let it, therefore, be considered that the organs* of plants are tubes, the filling, unfolding, and distending whereof by liquors, doth constitute what is called the vegetation or growth of the plant. But earth itself is not soluble in water, so as to form one vegetable fluid therewith. Therefore the particles of earth must be joined with a watery acid, that is, they must become salts in order to dissolve in water; that so, in the form of a vegetable juice, they may pass through the strainers and tubes of the root into the body of the plant, swelling and distending its parts and organs, that is, increasing its bulk. Therefore the vegetable matter of the earth is in effect earth changed into salt. And to render earth fertile, is to cause many of its particles to assume a saline form.

128. Hence it is observed, there are more salts in the root than in the bark, more salts in vegetables during the spring than in the autumn or winter, the crude saline juices being in the summer months partly evaporated, and partly ripened by the action and mixture of light. Hence also it appears, why the dividing of earth, so as to enlarge its surface, whereby it may admit more acid from the air, is of such use in promoting vegetation. And why ashes, lime, and burnt clay are found so profitable manures, fire being in reality the acid, as is proved in the sequel.† Marls also and shells are useful, forasmuch as those alkaline bodies attract the acid, and raise an effervescence with it, thereby promoting a fermentation in the glebe. The excrements of animals and putrid vegetables do in like manner contribute to vegetation, by increasing the salts of the earth. And where fallows are well broken, and lie long to receive the acid of the air into all their parts: this alone will be sufficient to change many terrene particles into salts, and consequently render them soluble in water, and therefore a fit aliment for vegetables.

129. The acid, saith Homberg, is always joined to some sulphur, which determines it to this or that species, producing different salts, as it is the vegetable bituminous, or metallic sulphur. Even the alkaline, whether volatile or lixivial salts, are supposed to be nothing but this same acid strictly detained by oil and earth, in spite of the extreme force of fire which lodgeth in them, without being able to dislodge some remains of the acid.

130. Salts, according to Sir Isaac Newton, are dry earth and watery acid united by attraction, the acid rendering them soluble

* Sect. 30, 31, 35. † Sect. 202.

in water.* He supposeth the watery acid to flow round the terrestrial part, as the ocean doth round the earth, being attracted thereby, and compares each particle of salt to a chaos, whereof the innermost part is hard and earthy, but the surface soft and watery. Whatever attracts and is attracted most strongly, is an acid in his sense.

131. It seems impossible to determine the figures of particular salts. All acid solvents together with the dissolved bodies are apt to shoot into certain figures. And the figures, in which the fossil salts crystallize, have been supposed the proper natural shapes of them and their acids. But Homberg hath clearly shown the contrary: forasmuch as the same acid dissolving different bodies, assumes different shapes. Spirit of nitre, for instance, having dissolved copper shoots into hexagonal crystals; the same having dissolved iron, shoots into irregular squares; and again, having dissolved silver forms thin crystals of a triangular figure.

132. Homberg, nevertheless, holds in general, that acids are shaped like daggers, and alkalies like sheaths: and that moving in the same liquor, the daggers run into the sheaths fitted to receive them, with such violence as to raise that effervescence observed in the mixture of acids and alkalies. But it seems very difficult to conceive, how or why the mere configuration of daggers and sheaths, floating in the same liquor, should cause the former to rush with such vehemence, and direct their points so aptly into the latter, any more than a parcel of spigots and fossets floating together in the same water, should rush one into the other.

133. It should seem rather, that the vehement attraction which Sir Isaac Newton attributes to all acids, whereby he supposeth them to rush towards, penetrate, shake and divide the most solid bodies, and to ferment the liquid of vegetables, could better account for this phenomenon. It is in this attraction, that Sir Isaac placeth all their activity, and indeed it should seem, the figures of salts were not of such efficacy in producing their effects, as the strong active powers whereby they are agitated and do agitate other bodies. Especially if it be true (what was before remarked) that lixivious salts are alike purgative, whatever may be the shape of their angles, whether more or less acute or obtuse.

134. Sir Isaac Newton accounts for the watery acids making earthy corpuscles soluble in water, by supposing the acid to be a mean between earth and water, its particles greater than those of water, and less than those of earth, and strongly to attract both. But perhaps there is no necessary reason for supposing the parts of the acid grosser than the parts of water, in order to produce

* Sect. 127.

this effect; may not this as well be accounted for, by giving them only a strong attraction or cohesion with the bodies to which they are joined?

135. The acid spirit or salt, that mighty instrument in the hand of nature, residing in the air, and diffused throughout that whole element, is discernible also in many parts of the earth, particularly in fossils, such as sulphur, vitriol, and alum; it was already observed from Homberg, that this acid is never found pure, but hath always sulphur joined with it, and is classed by the difference of its sulphurs, whether mineral, vegetable, or animal.

136. Salts are vulgarly reckoned the most active of chymical principles. But Homberg derives all their activity from the sulphurs joined with them. From which also, as hath been said, he derives all their kinds and differences.* Salt, water, oil, and earth seem to be originally the same in all vegetables. All the difference, according to the chymists, ariseth from a spirit residing in the oil, called the rector or archæus. This is otherwise called by chymists, *ens primum*, or the native spirit, whereon depend, and wherein are contained, the peculiar flavour and odour, the specific qualities and virtues of the plant.

137. These native spirits or vegetable souls are all breathed or exhaled into the air, which seems the receptacle as well as source of all sublunary forms, the great mass or chaos which imparts and receives them. The air or atmosphere that surrounds our earth contains a mixture of all the active volatile parts of the whole habitable world, that is of all vegetables, minerals, and animals. Whatever perspires, corrupts, or exhales, impregnates the air; which, being acted upon by the solar fire, produceth within itself all sorts of chemical operations, dispensing again those salts and spirits in new generations, which it had received from putrefactions.

138. The perpetual oscillations of this elastic and restless element operate without ceasing on all things that have life, whether animal or vegetable, keeping their fibres, vessels, and fluids in a motion always changing; as heat, cold, moisture, dryness, and other causes alter the elasticity of the air. Which accounts, it must be owned, for many effects. But there are many more which must be derived from other principles or qualities in the air. Thus iron and copper are corroded and gather rust in the air, and bodies of all sorts are dissolved or corrupted, which showeth an acid to abound and diffuse itself throughout the air.

139. By this same air fire is kindled, the lamp preserved, respiration, digestion, nutrition, the pulse of the heart and motion of all the muscles seem to be performed. Air therefore is a general agent, not only exerting its own, but calling forth the

* Sect. 129.

qualities or powers of all other bodies, by a division, comminution, and agitation of their particles, causing them to fly off and become volatile and active.

140. Nothing ferments, vegetates, or putrifies without air, which operates with all the virtues of the bodies included in it; that is, of all nature; there being no drug, salutary or poisonous, whose virtues are not breathed into the air. The air therefore is an active mass of numberless different principles, the general source of corruption and generation; on one hand dividing, abrading, and carrying off the particles of bodies, that is, corrupting or dissolving them; on the other, producing new ones into being; destroying and bestowing forms without intermission.

141. The seeds of things seem to lie latent in the air, ready to appear and produce their kind, whenever they light on a proper matrix. The extremely small seeds of fern, mosses, mushrooms, and some other plants are concealed and wafted about in the air, every part whereof seems replete with seeds of one kind or other. The whole atmosphere seems alive. There is every where acid to corrode, and seed to engender. Iron will rust, and mold will grow in all places. Virgin earth becomes fertile, crops of new plants ever and anon show themselves, all which demonstrates the to be a common seminary and receptacle of all vivifying principles.

142. Air may also be said to be the seminary of minerals and metals, as it is of vegetables. Mr. Boyle informs us, that the exhausted ores of tin and iron being exposed to the air become again impregnated with metal, and that ore of alum having lost its salt recovers it after the same manner. And numberless instances there are of salts produced by the air, that vast collection or treasury of active principles, from which all sublunary bodies seem to derive their forms, and on which animals depend for their life and breath.

143. That there is some latent vivifying spirit dispersed throughout the air common experience showeth; insomuch as it is necessary both to vegetables and animals* whether terrestrial or aquatic, neither beasts, insects, birds nor fishes being able to subsist without air. Nor doth all air suffice, there being some quality or ingredient, of which when air is deprived, it becometh unfit to maintain either life or flame. And this even though the air should retain its elasticity; which, by the by, is an argument that air doth not act only as an antagonist to the intercostal muscles. It hath both that and many other uses. It gives and preserves a proper tone to the vessels: this elastic fluid promotes all secretions: its oscillations keep every part in motion: it pervades and actuates the whole animal system, producing great variety of effects, and even opposite in different

* Sect. 138, 139.

parts, cooling at the same time and heating, distending and contracting, coagulating and resolving, giving and taking, sustaining life and impairing it, pressing without and expanding within, abrading some parts, at the same time insinuating and supplying others, producing various vibrations in the fibres, and ferments in the fluids; all which must needs ensue from such a subtile, active, heterogeneous, and elastic fluid.

144. But there is, as we before observed, some one quality or ingredient in the air, on which life more immediately and principally depends. What that is, though men are not agreed, yet it is agreed it must be the same thing that supports the vital and the common flame; it being found that when air, by often breathing in it, is become unfit for the one, it will no longer serve for the other. The like is observable in poisonous damps or steams, wherein flame cannot be kindled. As is evident in the grotto del cane near Naples. And here it occurs, to recommend the plunging them in cold water, as an experiment to be tried on persons affected by breathing a poisonous vapour in old vaults, mines, deep holes or cavities under ground. Which, I am apt to think, might save the lives of several, by what I have seen practised on a dog convulsed and in all appearance dead, but instantly reviving on being taken out of the above-mentioned grotto and thrown into a lake adjacent.

145. Air the general menstruum and seminary, seemeth to be only an aggregate of the volatile parts of all natural beings, which variously combined and agitated produceth many various effects. Small particles in a near and close situation strongly act upon each other, attracting, repelling, vibrating. Hence divers fermentations, and all the variety of meteors, tempests, and concussions both of earth and firmament. Nor is the microcosm less affected thereby. Being pent up in the viscera, vessels, and membranes of the body, by its salts, sulphurs, and elastic power, it engenders colics, spasms, hysteric disorders, and other maladies.

146. The specific quality of air is taken to be permanent elasticity. Mr. Boyle is expressly of this opinion. And yet, whether there be any such thing as permanently elastic air may be doubted, there being many things which seem to rob the air of this quality, or at least lessen and suspend its exertion. The salts and sulphurs, for instance, that float in the air abate much of its elasticity by their attraction.

147. Upon the whole it is manifest, that air is no distinct element, but a mass or mixture of things the most heterogeneous and even opposite to each other* which become air, by acquiring an elasticity and volatility from the attraction of some active, subtile substance; whether it be called fire, æther, light or the

* Sect. 137, 145.

vital spirit of the world; in like manner as the particles of antimony, of themselves not volatile, are carried off in sublimation and rendered volatile, by cohering with the particles of sal ammoniac. But action and reaction being equal, the spring of this etherial spirit is diminished by being imparted. Its velocity and subtilty are also less, from its being mixed with grosser particles. Hence sound moves slower than light, as mud than water.

148. Whether air be only freed and fixed, or generated and destroyed, it is certain that air begins and ceases to exert or show itself. Much by experiments seems to be generated, not only from animals, fruits, and vegetables, but also from hard bodies. And it is observed by Sir Isaac Newton, that air produced from hard bodies is most elastic. The transmutation of elements, each into other, hath been anciently held. In Plutarch we find it was the opinion of Heraclitus, that the death of fire was a birth to air, and the death of air a birth to water. This opinion is also maintained by Sir Isaac Newton. Though it may be questioned, whether what is thought a change be not only a disguise.

149. Fire seems the most elastic and expansive of all bodies. It communicates this quality to moist vapours and dry exhalations, when it heats and agitates their parts, cohering closely with them, overcoming their former mutual attraction, and causing them, instead thereof, reciprocally to repel each other and fly asunder, with a force proportionable to that wherewith they had cohered.

150. Therefore in air we may conceive two parts, the one more gross which was raised and carried off from the bodies of this terraqueous mass: the other a fine subtile spirit, by means whereof the former is rendered volatile and elastic. Together they compose a medium, whose elasticity is less than that of pure ether, fire, or spirit, in proportion to the quantity of salts, vapours, and heterogeneous particles contained therein. Hence, it follows, that there is no such thing as pure simple element of air. It follows also, that on the highest mountains, air should be more rare than in proportion to the vulgar rule, of the spaces being reciprocally as the pressures: and so in fact it is said to have been found, by the gentlemen of the French academy of sciences.

151. Ether, fire, or spirit, being attracted and clogged by heterogeneous particles, becometh less active; and the particles cohering with those of ether, become more active than before. Air therefore is a mass of various particles, abraded and sublimated from wet and dry bodies of all sorts, cohering with particles of ether; the whole permeated by pure ether, or light, or fire: for these words are used promiscuously by ancient philosophers.

152. This ether or pure invisible fire, the most subtile and elastic of all bodies, seems to pervade and expand itself throughout the whole universe. If air be the immediate agent or instrument in natural things, it is the pure invisible fire that is the first natural mover or spring, from whence the air derives its power.* This mighty agent is every where at hand, ready to break forth into action, if not restrained and governed with the greatest wisdom. Being always restless and in motion, it actuates and enlivens the whole visible mass, is equally fitted to produce and to destroy, distinguishes the various stages of nature, and keeps up the perpetual round of generations and corruptions, pregnant with forms which it constantly sends forth and resorbs. So quick in its motions, so subtile and penetrating in its nature, so extensive in its effects, it seemeth no other than the vegetative soul or vital spirit of the world.

153. The animal spirit in man is the instrumental or physical cause both of sense and motion. To suppose sense in the world would be gross and unwarranted. But locomotive faculties are evident in all its parts. The Pythagoreans, Platonists, and Stoics, held the world to be an animal: though some of them have chosen to consider it as a vegetable. However, the phenomena and effects do plainly show there is a spirit that moves, and a mind or providence that presides. This providence, Plutarch saith, was thought to be in regard to the world what the soul is in regard to man.

154. The order and course of things, and the experiments we daily make, show there is a mind that governs and actuates this mundane system, as the proper real agent and cause. And that the inferior instrumental cause is pure ether, fire, or the substance of light,† which is applied and determined by an infinite mind in the macrocosm or universe with unlimited power, and according to stated rules; as it is in the microcosm with limited power and skill by the human mind. We have no proof, either from experiment or reason, of any other agent or efficient cause than mind or spirit. When therefore we speak of corporeal agents or corporeal causes, this is to be understood in a different, subordinate, and improper sense.

155. The principles whereof a thing is compounded, the instrument used in its production, and the end for which it was intended, are all in vulgar use termed causes, though none of them be, strictly speaking, agent or efficient. There is not any proof that an extended corporeal or mechanical cause doth really and properly act, even motion itself being in truth a passion. Therefore, though we speak of this fiery substance as acting, yet it is to be understood only as a mean or instrument, which indeed is the case of all mechanical causes whatsoever. They are never-

* Sect. 139, 149, 151. † Sect. 29, 37, 136, 149.

theless sometimes termed agents and causes, although they are by no means active in a strict and proper signification. When, therefore, force, power, virtue, or action are mentioned as subsisting in an extended and corporeal or mechanical being, this is not to be taken in a true, genuine, and real, but only in a gross and popular sense, which sticks in appearances, and doth not analyze things to their first principles. In compliance with established language and the use of the world, we must employ the popular current phrase. But then in regard to truth we ought to distinguish its meaning. It may suffice to have made this declaration once for all, in order to avoid mistakes.

156. The *calidum innatum*, the vital flame or animal spirit in man, is supposed the cause of all motions, in the several parts of his body, whether voluntary or natural. That it is accounted the instrument, by means whereof the mind exerts and manifests herself in the motions of the body. In the same sense may not fire be said to have force, to operate, and agitate the whole system of the world, which is held together and informed by one presiding mind, and animated throughout by one and the same fiery substance, as an instrumental and mechanical agent, not as a primary real efficient.

157. This pure spirit or invisible fire is ever ready to exert and show itself in its effects,* cherishing, heating, fermenting, dissolving, shining and operating in various manners, where a subject offers to employ or determine its force. It is present in all parts of the earth and firmament, though perhaps latent and unobserved, till some accident produceth it into act, and renders it visible in its effects.

158. There is no effect in nature, great, marvellous, or terrible, but proceeds from fire, that diffused and active principle, which at the same time that it shakes the earth and heavens, will enter, divide, and dissolve the smallest, closest, and most compacted bodies. In remote cavities of the earth it remains quiet, till perhaps an accidental spark from the collision of one stone against another kindles an exhalation, that gives birth to an earthquake or tempest, which splits mountains or overturns cities. This same fire stands unseen in the focus of a burning glass, till subjects for it to act upon come in its way, when it is found to melt, calcine, or vitrify the hardest bodies.

159. No eye could ever hitherto discern, and no sense perceive, the animal spirit in a human body, otherwise than from its effects. The same may be said of pure fire, or the spirit of the universe, which is perceived only by means of some other bodies, on which it operates, or with which it is joined. What the chymists say of pure acids being never found alone might as well be said of pure fire.

* Sect. 152.

160. The mind of man acts by an instrument necessarily. The το ἡγεμονικὸν, or mind presiding in the world, acts by an instrument freely. Without instrumental and second causes, there could be no regular course of nature: and without a regular course, nature could never be understood. Mankind must always be at a loss, not knowing what to expect, or how to govern themselves, or direct their actions for the obtaining of any end. Therefore, in the government of the world, physical agents, improperly so called, or mechanical, or second causes, or natural causes, or instruments, are necessary to assist, not the governor, but the governed.

161. In the human body the mind orders and moves the limbs: but the animal spirit is supposed the immediate physical cause of their motion. So likewise in the mundane system a mind presides, but the immediate, mechanical, or instrumental cause, that moves or animates all its parts, is the pure elementary fire or spirit of the world. The more fine and subtile part or spirit is supposed to receive the impressions of the first mover, and communicate them to the grosser sensible parts of this world. Motion, though in metaphysical rigour and truth a passion or mere effect, yet in physics passeth for an action; and by this action all effects are supposed to be produced. Hence the various communications, determinations, accelerations of motion, constitute the laws of nature.

162. The pure ether or invisible fire contains parts of different kinds, that are impressed with different forces, or subjected to different laws of motion, attraction, repulsion, and expansion, and endued with divers distinct habitudes towards other bodies. These seem to constitute the many various qualities,* virtues, flavours, odours, and colours, which distinguish natural productions. The different modes of cohesion, attraction, repulsion, and motion, appear to be the source from whence the specific properties are derived, rather than different shapes or figures. This as hath been already observed, seems confirmed by the experiment of fixed salts operating one way, notwithstanding the difference of their angles. The original particles productive of odours, flavours, and other properties, as well as of colours, are, one may suspect, all contained and blended together in that universal and original seminary of pure elementary fire; from which they are diversly separated and attracted by the various subjects of the animal, vegetable, and mineral kingdoms; which thereby become classed into kinds, and endued with those distinct properties, which continue till their several forms, or specific proportions of fire return into the common mass.

163. As the soul acts immediately on pure fire, so pure fire operates immediately on air: that is, the abrasions of all terres-

* Sect. 37, 40—44.

trial things being rendered volatile and elastic by fire,* and at the same time lessening the volatility and expansive force of the fire, whose particles they attract and adhere to,† there is produced a new fluid, more volatile than water or earth, and more fixed than fire. Therefore the virtues and operations imputed to air, must be ultimately attributed to fire, as that which imparts activity to air itself.

164. The element of etherial fire or light seems to comprehend, in a mixed state, the seeds, the natural causes and forms‡ of all sublunary things. The grosser bodies separate, attract, and repel the several constituent particles of that heteregeneous element; which being parted from the common mass, make distinct essences, producing and combining together such qualities and properties, as are peculiar to the several subjects, and thence often extracted in essential oils or odoriferous waters, from whence they exhale into the open air, and return into their original element.

165. Blue, red, yellow, and other colours, have been discovered by Isaac Newton to depend on the parted rays or particles of light. And in like manner, a particular odour or flavour, seemeth to depend on peculiar particles of light or fire;§ as appears from heats being necessary to all vegetation whatsoever, and from the extreme minuteness and volatility of those vegetable souls or forms, flying off from the subjects without any sensible diminution of their weight. These particles blended in one common ocean, should seem to conceal the distinct forms, but, parted and attracted by proper subjects, disclose or produce them. As the particles of light which when separated form distinct colours, being blended are lost in one uniform appearance.

166. Agreeably thereto, an etherial substance or fire was supposed by Heraclitus to be the seed of the generation of all things, or that from which all things drew their original. The Stoics also taught, that all substance was originally fire, and should return to fire: that an active subtile fire was diffused or expanded throughout the whole universe; the several parts whereof were produced, sustained, and held together by its force. And it was the opinion of the Pythagoreans, as Laertius informs us, that heat or fire was the principle of life animating the whole system, and penetrating all the elements.‖ The Platonists too, as well as the Pythagoreans, held fire to be the immediate natural agent, or animal spirit; to cherish, to warm, to heat, to enlighten, to vegetate, to produce the digestions, circulations, secretions, and organical motions in all living bodies, vegetable or animal, being effects of that element, which, as it actuates the macrocosm, so it animates the microcosm. In the Timæus of

* Sect. 149, 150, 152. † Sect. 147. ‡ Sect. 43. § Sect. 40. ‖ Sect. 152, 153

Plato, there is supposed something like a net of fire, and rays of fire in a human body. Doth not this seem to mean the animal spirit, flowing, or rather darting through the nerves?

167. According to the Peripatetics, the form of heaven, or the fiery etherial substance, contains the forms of all inferior beings.* It may be said to teem with forms, and imparts them to subjects fitted to receive them. The vital force thereof in the Peripatetic sense is vital to all, but diversly received according to the diversity of the subjects. So all colours are virtually contained in the light; but their actual distinctions of blue, red, yellow, and the rest, depend on the difference of the objects which it illustrates. Aristotle in the book *De Mundo*, supposeth a certain fifth essence, an etherial nature unchangeable and impassive; and next in order a subtile, flaming substance, lighted up, or set on fire by that etherial and divine nature. He supposeth, indeed, that God is in heaven, but that his power, or a force derived from him, doth actuate and pervade the universe.

168. If we may credit Plutarch, Empedocles thought ether or heat to be Jupiter. Ether by the ancient philosophers was used to signify promiscuously sometimes fire and sometimes air. For they distinguish two sorts of air. Plato in the Timæus speaking of air saith there are two kinds, the one more fine and subtile, called ether, the other more gross and replete with vapours! This ether or purer medium seems to have been the air or principle from which all things, according to Anaximenes, derived their birth, and into which they were back again resolved at their death. Hippocrates in his treatise *De Diæta*, speaketh of a fire pure and invisible; and this fire, according to him, is that which stirring and giving movement to all things causes them to appear, or, as he styles it, come into evidence, that is to exist, every one in its time and according to its destiny.

169. This pure fire, ether, or substance of light, was accounted in itself invisible and imperceptible to all our senses, being perceived only by its effects, such as heat, flame, and rarefaction. To which we may add, that the moderns pretend farther to have perceived it by weight, inasmuch as the aromatic oils which most abound with fire, as being the most readily and vehemently inflamed, are above all others the heaviest. And by an experiment of Mr. Homberg's four ounces of regulus of antimony, being calcined by a burning glass for an hour together, were found to have imbibed and fixed seven drachms of the substance of light.

170. Such is the rarefying and expansive force of this element, as to produce in an instant of time the greatest and most stupendous effects: a sufficient proof not only of the power of fire, but also of the wisdom with which it is managed, and withheld from bursting forth every moment to the utter ravage and

* Sect. 43.

destruction of all things. And it is very remarkable, that this same element, so fierce and destructive, should yet be so variously tempered and applied, as to be withal the salutary warmth, the genial, cherishing and vital flame of all living creatures. It is not therefore to be wondered that Aristotle thought, the heat of a living body to be somewhat divine and celestial, derived from that pure ether to which he supposed the incorporeal deity (χωριστὸν εἶδος) to be immediately united, or on which he supposed it immediately to act.

171. The Platonists held that intellect resided in soul, and soul in an etherial vehicle. And that as the soul was a middle nature, reconciling intellect with ether, so ether was another middle nature, which reconciled and connected the soul with grosser bodies.* Galen likewise taught that, admitting the soul to be incorporeal, it hath for its immediate tegument or vehicle a body of ether or fire, by the intervention whereof it moveth other bodies, and is mutually affected by them. This interior clothing was supposed to remain upon the soul, not only after death, but after the most perfect purgation, which, in length of time, according to the followers of Plato and Pythagoras, cleansed the soul,—

——————— purumque reliquit
Æthereum sensum atque auraï simplicis ignem.

This tunicle of the soul, whether it be called pure ether, or luciform vehicle, or animal spirit, seemeth to be that which moves and acts upon the gross organs, as it is determined by the soul, from which it immediately receives impression, and in which the moving force truly and properly resides. Some moderns have thought fit to deride all that is said of etherial vehicles, as mere jargon or words without a meaning. But they should have considered, that all speech concerning the soul is altogether, or for the most part, metaphorical; and that, agreeably thereunto, Plato speaketh of the mind or soul as a driver, that guides and governs a chariot, which is not unfitly styled αὐγοειδὲς, a luciform ethereal vehicle, or ὄχημα, terms expressive of the purity, lightness, subtilty, and mobility, of that fine celestial nature, in which the soul immediately resides and operates.

172. It was a tenet of the Stoics that the world was an animal, and that providence answered to the reasonable soul in man. But then the providence or mind was supposed by them, to be immediately resident or present in fire, to dwell therein, and to act thereby. Briefly, they conceived God to be an intellectual and fiery spirit, πνεῦμα νοερὸν καὶ πυρῶδες. Therefore, though they looked on fire † as the τὸ ἡγεμονικὸν, or governing

* Sect. 152, 154. † Sect. 166.

principle of the world; yet it was not simply fire, but animated with a mind.

173. Such are the bright and lively signatures of a divine mind, operating and displaying itself in fire and light throughout the world, that, as Aristotle observes in his book *De Mundo*, all things seem full of divinities, whose apparitions on all sides strike and dazzle our eyes. And it must be owned, the chief philosophers and wise men of antiquity, how much soever they attributed to second causes and the force of fire, yet they supposed a mind or intellect always resident therein, active or provident, restraining its force and directing its operations.

174. Thus Hippocrates, in his treatise *De Diæta*, speaks of a strong but invisible fire,* that rules all things without noise. Herein, saith he, resides soul, understanding, prudence, growth, motion, diminution, change, sleep, and waking. This is what governs all things, and is never in repose. And the same author, in his tract *De Carnibus*, after a serious preface, setting forth that he is about to declare his own opinion, expresseth it in these terms. That which we call heat, θερμὸν, appears to me something immortal, which understands all things, which sees and knows both what is present and what is to come.

175. This same heat is also what Hippocrates calls nature, the author of life and death, good and evil. It is further to be noted of this heat, that he maketh it the object of no sense. It is that occult, universal nature, and inward invisible force, which actuates and animates the whole world, and was worshipped by the ancients under the name of Saturn; which Vossius judges not improperly to be derived from the Hebrew word *satar*, to lie hidden or concealed. And what hath been delivered by Hippocrates, agrees with the notions of other philosophers: Heraclitus,† for instance, who held fire to be the principle and cause of the generation of all things, did not mean thereby an inanimate element, but, as he termed it, πῦρ ἀείζωον, an everlasting fire.

176. Theophrastus, in his book *De Igne*, distinguisheth between heat and fire. The first he considers as a principle or cause, not that which appeareth to sense as a passion or accident existing in a subject, and which is, in truth, the effect of that unseen principle. And it is remarkable, that he refers the treating of this invisible fire or heat, to the investigation of the first causes. Fire, the principle, is neither generated nor destroyed, is every where and always present:‡ while its effects, in different times and places, show themselves more or less, and are very various, soft and cherishing, or violent and destructive, terrible or agreeable, conveying good and evil, growth and decay, life and death, throughout the mundane system.

* Sect. 168. † Sect. 166. ‡ Sect. 157.

177. It is allowed by all, that the Greeks derived much of their philosophy from the Eastern nations. And Heraclitus is thought by some, to have drawn his principles from Orpheus, as Orpheus did from the Egyptians; or, as others write, he had been auditor of Hippasus, a Pythagorean, who held the same notion of fire, and might have derived it from Egypt by his master Pythagoras, who had travelled into Egypt, and been instructed by the sages of that nation. One of whose tenets it was, that fire was the principle of all action; which is agreeable to the doctrine of the Stoics, that the whole of things is administered by a fiery intellectual spirit. In the Asclepian Dialogue we find this notion, that all parts of the world vegetate by a fine subtile ether, which acts as an engine or instrument, subject to the will of the supreme God.

178. As the Platonists held intellect to be lodged in soul, and soul in ether;* so it passeth for a doctrine of Trismegistus, in the Pimander, that mind is clothed by soul, and soul by spirit. Therefore as the animal spirit of man, being subtile and luminous; is the immediate tegument of the human soul, or that wherein and whereby she acts; even so the spirit of the world, that active fiery ethereal substance of light, that permeates and animates the whole system, is supposed to clothe the soul, which clothes the mind of the universe.

179. The Magi likewise said to God, that he had light for his body and truth for his soul. And in the Chaldaic oracles, all things are supposed to be governed by a πῦρ νοερὸν, or intellectual fire. And in the same oracles, the creative mind is said to be clothed with fire: ἐσθαμένος πυριπῦρ, which oriental reduplication of the word fire seems to imply the extreme purity and force thereof. Thus also in the Psalms, Thou art clothed with light as with a garment. Where the word rendered light might have been rendered fire, the Hebrew letters being the same with those in the word which signifies fire, all the difference being in the pointing, which is justly counted a late invention. That other scripture sentence is remarkable: Who maketh his ministers a flaming fire: which might, perhaps, be rendered more agreeably to the context, as well as consistently with the Hebrew, after this manner: Who maketh flaming fire his ministers: and the whole might run thus: Who maketh the winds his messengers, and flaming fire his ministers.

180. A notion of something divine in fire, animating the whole world, and ordering its several parts, was a tenet of very general extent† being embraced in the most distant times and places, even among the Chinese themselves: who make *tien*, ether, or heaven, the sovereign principle or cause of all things,

* Sect. 171. † Sect. 156, 157, 163, 166—168, 170, 172—175, 177, &c.

and teach that the celestial virtue, by them called *li*, when joined to corporeal substance, doth fashion, distinguish, and specificate all natural beings. This *li* of the Chinese seems to answer the forms of the Peripatetics. And both bear analogy to the foregoing philosophy of fire.

181. The heaven is supposed pregnant with virtues and forms, which constitute and discriminate the various species of things. And we have more than once observed, that as the light, fire, or celestial ether, being parted by refracting or reflecting bodies, produceth variety of colours; even so, that same apparently uniform substance being parted and secreted by the attracting and repelling powers of the divers secretory ducts of plants and animals, that is, by natural chymistry, produceth or imparteth the various specific properties of natural bodies. Whence the tastes and odours and medicinal virtues so various in vegetables.

182. The *tien* is considered and adored by the learned Chinese as living and intelligent ether, the πῦρ νοερὸν of the Chaldæans and the Stoics. And the worship of things celestial, the sun and stars, among the eastern nations less remote, was on account of their fiery nature, their heat and light, and the influence thereof. Upon these accounts, the sun was looked on by the Greek theologers as the spirit of the world, and the power of the world. The cleansing quality, the light and heat of fire, are natural symbols of purity, knowledge, and power, or if I may so say, the things themselves so far as they are perceptible to our senses, or in the same sense as motion is said to be action. Accordingly, we find a religious regard was paid to fire, both by Greeks and Romans, and indeed by most, if not all, the nations of the world.

183. The worship of Vesta at Rome was, in truth, the worship of fire.

Nec tu aliud Vestam quam vivam intellige flammam,

Saith Ovid in his Fasti. And as in old Rome the eternal fire was religiously kept by virgins, so in Greece, particularly at Delphi and Athens, it was kept by widows. It is well known that Vulcan or fire was worshipped with great distinction by the Egyptians. The Zabii or Sabeans are also known to have been worshippers of fire. It appears, too, from the Chaldean oracles, that fire was regarded as divine by the sages of that nation. And it is supposed that Ur of the Chaldæans was so called from the Hebrew word signifying fire, because fire was publicly worshipped in that city. That a religious worship was paid to fire by the ancient Persians and their Magi, is attested by all antiquity. And the sect of Parsees, or old Gentiles, of whom there are considerable remains at this day both in the Moguls' country and in Persia doth testify the same.

184. It doth not seem that their prostrations before the perpetual fires, preserved with great care in their Pyreia, or fire temples, were merely a civil respect, as Dr. Hyde would have it thought. Although he brings good proof that they do not invoke the fire on their altars, or pray to it, or call it God: and that they acknowledge a supreme invisible deity. Civil respects are paid to things as related to civil power: but such relation doth not appear in the present case. It should seem, therefore, that they worship God as present in the fire, which they worship or reverence, not ultimately or for itself, but relatively to the supreme being. Which it is not unlikely was elsewhere the case at first; though the practice of men, especially of the vulgar, might in length of time degenerate from the original institution, and rest in the object of sense.

185. Doctor Hyde, in his history of the religion of the ancient Persians, would have it thought that they borrowed the use and reverence of perpetual fires from the Jewish practice prescribed in the Levitical law, of keeping a perpetual fire burning on the altar. Whether that was the case or not, thus much one may venture to say, it seems probable that whatever was the original of this custom among the Persians, the like customs among the Greeks and Romans were derived from the same source.

186. It must be owned there are many passages in holy scripture,* that would make one think the supreme being was in a peculiar manner present and manifest in the element of fire. Not to insist that God is more than once said to be a consuming fire, which might be understood in a metaphorical sense, the divine apparitions were by fire in the bush, at mount Sinai, on the tabernacle, in the cloven tongues. God is represented in the inspired writings as descending in fire, as attended by fire, or with fire going before him. Celestial things as angels, chariots, and such like phenomena, are invested with fire, light, and splendour. Ezekiel in his visions beheld fire and brightness, lamps, burning coals of fire, and flashes of lightning. In a vision of Daniel, the throne of God appeared like a fiery flame, and his wheels like burning fire. Also a fiery flame issued and came forth from before him.

187. At the transfiguration the apostles saw our Saviour's face shining as the sun, and his raiment white as light, also a lucid cloud or body of light, out of which the voice came; which visible light and splendour was, not many centuries ago, maintained by the Greek church to have been divine, and uncreated, and the very glory of God; as may be seen in the history wrote by the emperor John Cantacuzene. And of late years bishop Patrick gives it as his opinion, that in the beginning of the world, the Shecinah, or divine presence, which was then

* Sect. 179.

frequent and ordinary, appeared by light or fire. In commenting on that passage, where Cain is said to have gone out from the presence of the Lord, the bishop observes that Cain, after this, turned a downright idolater, as many think, it is very likely he introduced the worship of the sun, as the best resemblance he could find of the glory of the Lord, which was wont to appear in a flaming light. It would be endless to enumerate all the passages of holy scripture which confirm and illustrate this notion, or represent the Deity as appearing and operating by fire. The misconstruction of which might possibly have misled the Gnostics, Basilidians, and other ancient heretics into an opinion, that Jesus Christ was the visible corporeal sun.

188. We have seen, that in the most remote ages and countries, the vulgar as well as the learned, the institutions of lawgivers, as well as the reasonings of philosophers, have ever considered the element of fire in a peculiar light, and treated it with more than common regard, as if it were something of a very singular and extraordinary nature. Nor are there wanting authors of principal account among the moderns, who entertain like notions concerning fire, especially among those who are most conversant in that element, and should seem best acquainted with it.

189. Mr. Homberg, the famous modern chymist, who brought that art to so great perfection, holds the substance of light or fire to be the true chymic principle sulphur,* and to extend itself throughout the whole universe. It is his opinion that this is the only active principle. That mixed with various things it formeth several sorts of natural productions: with salts making oil, with earth bitumen, with mercury metal. That this principle of sulphur, fire, or the substance of light, is in itself imperceptible, and only becomes sensible, as it is joined with some other principle, which serves as a vehicle for it. That, although it be the most active of all things, yet it is at the same time the most firm bond and cement to combine and hold the principles together, and give form to the mixed bodies. And that in the analysis of bodies it is always lost, escaping the skill of the artist, and passing through the closest vessels.

190. Boerhaave, Niewenty't, and divers other moderns, are in the same way of thinking. They with the ancients distinguish a pure elementary, invisible fire from the culinary, or that which appears in ignited bodies.* This last they will not allow to be pure fire. The pure fire is to be discerned by its effects alone; such as heat, dilation of all solid bodies, and rarefaction of fluids, the segregating heterogeneous bodies, and congregating those that are homogeneous. That therefore which smokes and flames is not pure fire, but that which is collected in the focus of a concave mirror or burning glass. This fire seems the source of all the

* Sect. 129. § Sect. 163, 166.

operations in nature: without it nothing either vegetates, or putrefies, lives or moves or ferments, is dissolved or compounded or altered, throughout this whole natural world in which we subsist. Were it not for this, the whole would be one great stupid inanimate mass. But this active element is supposed to be every where, and always present, imparting different degrees of life, heat, and motion, to the various animals, vegetables, and other natural productions, as well as to the elements themselves, wherein they are produced and nourished.

191. As water acts upon salt, or aqua fortis upon iron, so fire dissolves all other bodies. Fire, air, and water are all three menstruums: but the two last seem to derive all their force and activity from the first.* And indeed there seems so be, originally or ultimately, but one menstruum in nature, to which all other menstruums may be reduced. Acid salts are a menstruum, but their force and distinct powers are from sulphur. Considered as pure, or in themselves, they are all of the same nature. But, as obtained by distillation, they are constantly joined with some sulphur, which characteriseth and cannot be separated from it. This is the doctrine of Monsieur Homberg. But what is it that characteriseth or differenceth the sulphurs themselves? If sulphur be the substance of light, as that author will have it, whence is it that animal, vegetable, and metallic sulphurs impart different qualities to the same acid salt? Can this be explained upon Homberg's principles? And are we not obliged to suppose, that light separated by the attracting and repelling powers in the strainers, ducts, and pores of those bodies, doth form several distinct kinds of sulphur, all which, before such separation, were lost and blended together, in one common mass of light or fire, seemingly homogeneous.

192. In the analysis of inflammable bodies, the fire or sulphur is lost, and the diminution of weight showeth the loss.† Oil is resolved into water, earth, and salt, none of which is inflammable. But the fire or vinculum which connected those things, and gave the form of oil, escapes from the artist. It disappears but is not destroyed. Light or fire imprisoned made part of the compound, gave union to the other parts, and form to the whole. But having escaped, it mingles with the general ocean of ether, till being again parted and attracted, it enters and specificates some new subject, of the animal, vegetable, or mineral kingdom. Fire therefore in the sense of philosophers is always fire, though not always flame.

193. Solar fire or light, in calcining certain bodies, is observed to add to their weight. There is therefore no doubt but light can be fixed, and enter the composition of a body. And though it

* Sect. 149. † Sect. 169.

should lie latent for a long time, yet being set free from its prison it shall still show itself to be fire. Lead, tin, or regulus of antimony, being exposed to the fire of a burning glass, though they lose much in smoke and steam, are nevertheless found to be considerably increased in weight, which proves the introduction of light or fire into their pores. It is also observed, that urine produceth no phosphorus, unless it be long exposed to the solar light. From all which it may be concluded, that bodies attract and fix the light, whence it should seem, as some have observed, that fire without burning is an ingredient in many things, as water without wetting.

194. Of this there cannot be a better proof, than the experiment of Monsieur Homberg, who made gold of mercury by introducing light into its pores, but at such trouble and expense, that I suppose nobody will try the experiment for profit. By this injunction of light and mercury, both bodies became fixed, and produced a third different from either, to wit, real gold. For the truth of which fact, I refer to the memoirs of the French academy of sciences. From the foregoing experiment it appears, that gold is only a mass of mercury penetrated and cemented by the substance of light, the particles of those bodies attracting and fixing each other. This seems to have been not altogether unknown to former philosophers, Marcilius Ficinus the Platonist, in his commentary on the first book of the second Æneid of Plotinus, and others likewise before him, regarding mercury as the mother, and sulphur as the father of metals: and Plato himself in his Timæus describing gold, to be a dense fluid with a shining yellow light, which well suits a composition of light and mercury.

195. Fire or light mixeth with all bodies,* even with water; witness the flashing lights in the sea, whose waves seem frequently all on fire. Its operations are various according to its kind, quantity, and degree of vehemence. One degree keeps water fluid, another turns it into elastic air.† And air itself seems to be nothing else but vapours and exhalations, rendered elastic by fire. Nothing flames but oil: and sulphur with water, salt, and earth, compose oil; which sulphur is fire, therefore fire inclosed attracts fire, and causeth the bodies whose composition it enters to burn and blaze.

196. Fire collected in the focus of a glass operates in vacuo, and therefore is thought not to need air to support it. Calx of lead hath gone off with an explosion in vacuo, which Niewenty't and others take for a proof that fire can burn without air. But Mr. Hales attributes this effect to air inclosed in the red lead, and perhaps too in the receiver, which cannot be perfectly exhausted. When common lead is put into the fire in order to make red lead, a greater weight of this comes out than was put in of common

* Sect. 157. † Sect. 149.

lead. Therefore the red lead should seem impregnated with fire. Mr. Hales thinks it is with air. The vast expansion of compound aqua fortis, Mr. Niewenty't will have to proceed from fire alone. Mr. Hales contends that air must necessarily co-operate. Though by Niewenty't's experiment it should seem, the phosphorus burns equally with and without air.

197. Perhaps they who hold the opposite sides in this question, may be reconciled by observing that air is in reality nothing more than particles of wet and dry bodies volatilized and rendered elastic by fire.* Whatever, therefore, is done by air must be ascribed to fire, which fire is a subtile invisible thing, whose operation is not to be discerned but by means of some grosser body, which serves not for a pabulum to nourish the fire, but for a vehicle to arrest and bring it into view. Which seems the sole use of oil, air, or any other thing, that vulgarly passeth for a pabulum or food of that element.

198. To explain this matter more clearly, it is to be observed, that fire, in order to become sensible, must have some subject to act upon. This being penetrated and agitated by fire affects us with light, heat, or some other sensible alteration. And this subject so wrought upon may be called culinary fire. In the focus of a burning glass exposed to the sun, there is real actual fire, though not discerned by the sense till it hath somewhat to work on, and can show itself in its effects, heating, flaming, melting, and the like. Every ignited body is, in the foregoing sense, culinary fire. But it will not therefore follow, that it is convertible into pure elementary fire. This, for ought that appears, may be ingenerable and incorruptible by the course of nature. It may be fixed and imprisoned in a compound,† and yet retain its nature, though lost to sense, and though it return into the invisible elementary mass, upon the analysis of the compounded body: as is manifest in the solution of stone lime by water.

199. It should seem, therefore, that what is said of air's being the pabulum of fire, or being converted into fire, ought to be understood only in this sense, to wit, that air being less gross than other bodies, is of a middle nature, and therefore more fit to receive the impressions of a fine etherial fire,‡ and impart them to other things. According to the ancients, soul serveth for a vehicle to intellect,§ and light or fire for a vehicle to the soul; and, in like manner, air may be supposed a vehicle to fire, fixing it in some degree, and communicating its effects to other bodies.

200. The pure invisible fire or ether doth permeate all bodies, even the hardest and most solid, as the diamond. This alone, therefore, cannot, as some learned men have supposed, be the

* Sect. 147, 150, 151. † Sect. 169, 192, 193. ‡ Sect. 163. § Sect. 178.

cause of muscular motion, by a mere impulse of the nerves communicated from the brain to the membranes of the muscles, and thereby to the inclosed ether, whose expansive motion, being by that means increased, is thought to swell the muscles, and cause a contraction of the fleshy fibres. This, it should seem, the pure ether cannot do immediately and of itself, because, supposing its expansive motion to be increased, it must still pass through the membranes, and consequently not swell them, inasmuch as ether is supposed freely to pervade the most solid bodies. It should seem, therefore, that this effect must be owing, not to pure ether, but to ether in some part fixed and arrested by the particles of air.

201. Although this ether be extremely elastic, yet as it is sometimes found by experience to be attracted, imprisoned, and detained in gross bodies,* so we may suppose it to be attracted, and its expansive force diminished, though it should not be quite fixed, by the loose particles of air, which combining and cohering therewith may bring it down, and qualify it for intercourse with grosser things. Pure fire may be said to animate air, and air other things. Pure fire is invisible; therefore flame is not pure fire. Air is necessary both to life and flame. And it is found by experiment, that air loseth in the lungs the power of feeding flame. Hence it is concluded, that the same thing in air contributes both to life and flame. Vital flame survives culinary flame in vacuo; therefore it requires less of that thing to sustain it.

202. What this may be, whether some certain proportion, or some peculiar parts of ether, is not easy to say. But thus much seems plain, that whatever is ascribed to acid may be also ascribed to fire or ether. The particles of ether fly asunder with the greatest force; therefore, agreeably to Sir Isaac Newton's doctrine, when united, they must attract each other with the greatest force. Therefore they constitute the acid. For whatsoever strongly attracts and is attracted may be called an acid, as Sir Isaac Newton informs us in his tract De Acido. Hence it should seem that the sulphur of Homberg and the acid of Sir Isaac are at bottom one and the same thing, to wit, pure fire or ether.

203. The vital flame or etherial spirit, being attracted and imprisoned in grosser bodies, seemeth to be set free and carried off by the superior attraction of a subtile and pure flame. Hence, perhaps it is, that lightning kills animals, and turns spirituous liquors vapid in an instant.

204. Hippocrates in his book concerning the heart observeth, that the soul of man is not nourished by meats and drinks from the lower belly, but by a pure and luminous substance darting its rays, and distributing a non-natural nourishment, as he terms it, in like manner as that from the intestines is distributed to all

* Sect. 169.

parts of the body. This luminous non-natural nourishment, though it be secreted from the blood, is expressly said not to come from the lower belly. It is plain, therefore, he thought it came into the blood either by respiration or by attraction through the pores. And it must be acknowledged, that somewhat igneous or ethereal brought by the air into the blood seems to nourish, though not the soul itself, yet the interior tunicle of the soul, the *auraï simplicis ignem.*

205. That there is really such a thing as vital flame, actually kindled, nourished, and extinguished like common flame, and by the same means, is an opinion of some moderns, particularly of Dr. Willis, in his tract *De Sanguinis Accensione:* that it requires constant eventilation, through the trachæa and pores of the body for the discharge of a fuliginous and excrementitious vapour: and that this vital flame, being extremely subtile, might not be seen any more than shining flies or *ignes fatui* by daylight. And yet it hath sometimes become visible on divers persons, of which there are undoubted instances. This is Dr. Willis's notion: and perhaps there may be some truth in this, if it be so understood, as that light or fire might indeed constitute the animal spirit or immediate vehicle of the soul.

206. There have not been wanting those who, not content to suppose light the most pure and refined of all corporeal beings, have gone further, and bestowed upon it some attributes of a yet higher nature. Julianus, the Platonic philosopher, as cited by Ficinus, saith it was a doctrine in the theology of the Phœnicians, that there is diffused throughout the universe a pellucid and shining nature, pure and impassive, the act of a pure intelligence. And Ficinus himself undertakes to prove, that light is incorporeal by several arguments: because it enlightens and fills a great space in an instant and without opposition; because several lights meet without resisting each other; because light cannot be defiled by filth of any kind; because the solar light is not fixed in any subject: lastly, because it contracts and expands itself so easily without collision, condensation, rarefaction, or delay, throughout the vastest space. These reasons are given by Ficinus, in his comment on the first book of the second Æneid of Plotinus.

207. But it is now well known that light moves, and that its motion is not instantaneous; that it is capable of condensation, rarefaction, and collision; that it can be mixed with other bodies, enter their composition, and increase their weight.* All which seems sufficiently to overthrow those arguments of Ficinus, and show light to be corporeal. There appears, indeed, some difficulty at first sight, about the non-resistance of rays or particles of light occurring one to another, in all possible directions, or

* Sect. 169, 192, 193.

from all points. Particularly, if we suppose the hollow surface of a large sphere, studded with eyes looking inwards one at another, it may perhaps seem hard to conceive, how distinct rays from every eye should arrive at every other eye without justling, repelling, and confounding each other.

208. But these difficulties may be got over by considering in the first place, that visible points are not mathematical points, and consequently that we are not to suppose every point of space a radiating point. Secondly, by granting that many rays do resist and intercept each other, notwithstanding which the act of vision may be performed. Since as every point of the object is not seen, so it is not necessary that rays from every such point arrive at the eye. We often see an object, though more dimly, when many rays are intercepted by a gross medium.

209. Besides, we may suppose the particles of light to be indefinitely small, that is as small as we please, and their aggregate to bear as small a proportion to the void as we please, there being nothing in this that contradicts the phenomena. And there needs nothing more, in order to conceive the possibility of rays passing from and to all visible points, although they be not incorporeal. Suppose a hundred ports placed round a circular sea, and ships sailing from each port to every other; the larger the sea, and the smaller the vessels are supposed, the less danger will there be of their striking against each other. But as there is by hypothesis no limited proportion between the sea and the ships, the void and solid particles of light, so there is no difficulty that can oblige us to conclude the sun's light incorporeal from its free passage; especially when there are so many clear proofs of the contrary. As for the difficulty, therefore, attending the supposition of a sphere studded with eyes looking at each other, this is removed only by supposing the particles of light exceeding small relatively to the empty spaces.

210. Plotinus supposeth, that from the sun's light which is corporeal, there springs forth another equivocal light which is incorporeal, and as it were the brightness of the former. Marcilius Ficinus also observing it to be a doctrine in the Timæus of Plato, that there is an occult fire or spirit diffused throughout the universe, intimates that this same occult invisible fire or light is, as it were, the sight of the mundane soul. And Plotinus in his fourth Æneid showeth it to be his opinion, that the world seeth itself and all its parts. The Platonic philosophers do wonderfully refine upon light, and soar very high: from coal to flame; from flame to light: from this visible light to the occult light of the celestial or mundane soul, which they supposed to pervade and agitate the substance of the universe by its vigorous and expansive motion.

211. If we may believe Diogenes Laertius, the Pythagorean

philosophers thought there was a certain pure heat or fire, which had somewhat divine in it, by the participation whereof men became allied to the Gods. And according to the Platonists, heaven is not defined so much by its local situation, as by its purity. The purest and most excellent fire, that is heaven, saith Ficinus. And again, the hidden fire that every where exerts itself, he calls celestial. He represents fire as most powerful and active, dividing all things, abhorring all composition or mixture with other bodies. And, as soon as it gets free, relapsing instantly into the common mass of celestial fire, which is every where present and latent.

212. This is the general source of life, spirit, and strength, and therefore, of health to all animals, who constantly receive its illapses clothed in air, through the lungs and pores of the body. The same spirit imprisoned in food and medicines, is conveyed into the stomach, the bowels, the lacteals, circulated and secreted by the several ducts, and distributed throughout the system.* Plato in his Timæus enumerating the ignited juices, names wine in the first place, and tar in the second. But wine is pressed from the grape, and fermented by human industry. Therefore of all ignited juices purely natural, tar or resin must in his account be esteemed the first.

213. The vivifying luminous ether exists in all places, even the darkest caverns, as is evident from hence, that many animals see in those dark places, and that fire may be kindled in them by the collision or attrition of bodies. It is also known that certain persons have fits of seeing in the dark. Tiberius was said to have had this faculty or distemper. I myself knew an ingenious man who had experienced it several times in himself. And Dr. Willis in his tract *De Sanguinis Accentione* mentions another of his own knowledge. This luminous ether or spirit is therefore said by Virgil, to nourish or cherish the innermost earth, as well as the heavens and celestial bodies.

> Principo cælum ac terras, camposque liquentes,
> Lucentemque globum lunæ, Titaniaque astra
> Spiritus intus alit.†—ÆNEID, vi. 724.

214. The principles of motion and vegetation in living bodies seem to be deliberations from the invisible fire or spirit of the universe:‡ which, though present to all things, is not nevertheless one way received by all; but variously imbibed, attracted, and secreted by the fine capillaries, and exquisite strainers in the

* Sect. 37, 42, 44.

† "Know first, a spirit, with an active *flame*,
Fills, feeds, and animates the mighty frame;
Runs thro' the watery worlds, the fields of air,
The pondrous earth, the depths of heaven, and there
Shines in the sun and moon, and every golden star.—PITT.

‡ Sect, 43, 157, 164, 171.

bodies of plants and animals, whereby it becomes mixed and detained in their juices.

215. It hath been thought by some observers of nature, that the fine glandular vessels admit from the common mass of the blood, only such juices as are homogeneous to those with which they were originally imbued. How they came to be so imbued doth not appear. But thus much is plain; that fine tubes attract fluids, that the glands are fine tubes, and that they attract very different juices from the common mass. The same holds also with regard to the capillary vessels* of vegetables, it being evident that through the fine strainers in the leaves and all over the plant, there be juices or fluids of a particular kind drawn in, and separated from the common mass of air and light. And that the most elaborate spirit, whereon the character or distinguishing virtue and properties of the plant depend, is of a luminous† and volatile nature, being lost or escaping into air or ether, from essential oils and odoriferous waters, without any sensible diminution of them.

216. As different kinds of secreted light or fire produce different essences, virtues, or specific properties, so also different degrees of heat produce different effects. Thus one degree of heat keeps the blood from coagulating, and another degree coagulates the blood. Thus a more violent fire hath been observed to set free and carry off that very light, which a more moderate fire had introduced and fixed in the calcined regulus of antimony. In like manner, one kind or quantity of this ethereal fiery spirit may be congenial and friendly to the spirits of a man, while another may be noxious.

217. And experience showeth this to be true. For the fermented spirit of wine or other liquors produceth irregular motions, and subsequent depressions in the animal spirits. Whereas the luminous spirit lodged and detained in the native balsam of pines and firs, is of a nature so mild and benign and proportioned to the human constitution, as to warm without heating, to cheer but not inebriate, and to produce a calm and steady joy like the effect of good news, without that sinking of spirits which is a subsequent effect of all fermented cordials. I may add, without all other inconvenience, except that it may like any other medicine be taken in too great a quantity for a nice stomach. In which case it may be right to lessen the dose, or to take it only once in the four and twenty hours, empty, going to bed (when it is found to be least offensive), or even to suspend the taking of it for a time, till nature shall seem to crave it, and rejoice in its benign and comfortable spirit.

218. Tar water serving as a vehicle to this spirit is both diuretic and diaphoretic, but seems to work its principal effect

* Sect. 30, 31, 33, 35. † Sect. 37, 43.

by assisting the *vis vitæ*, as an alterative and cordial, enabling nature by an accession of congenial spirit, to assimilate that which could not be assimilated by her proper force, and so to subdue the *fomes morbi*. And this should seem in most cases the best and safest course. Great evacuations weaken nature as well as the disease. And it is to be feared that they who use salivations and copious bleedings, may, though they should recover of the distemper, in their whole life be never able to recover of the remedies.

219. It is true indeed, that in chronical cases there is need of time to complete a cure, and yet I have known this tar water in disorders of the lungs and stomach to prove a very speedy remedy, and to allay the anxiety and heat of a fever in an instant, giving ease and spirits to the patient. This I have often experienced, not without surprise at seeing these salutary effects follow so immediately in a fever on taking a glass of tar water. Such is the force of these active vivifying principles contained in this balsam.

220. Force or power, strictly speaking, is in the agent alone who imparts an equivocal force to the invisible elementary fire, or animal spirit* of the world, and this to the ignited body or visible flame, which produceth the sense of light and heat. In this chain the first and last links are allowed to be incorporeal: the two intermediate are corporeal, being capable of motion, rarefaction, gravity, and other qualities of bodies. It is fit to distinguish these things, in order to avoid ambiguity concerning the nature of fire.

221. Sir Isaac Newton in his Optics asks, Is not a fire a body heated so hot as to emit light copiously? for what else, adds he, is a red hot iron than fire? Now it should seem, that to define fire by heat, would be to explain a thing by itself. A body heated so hot as to emit light is an ignited body, that is, hath fire in it, is penetrated and agitated by fire, but is not itself fire. And although it should in the third foregoing acceptation, or vulgar sense, pass for fire, yet it is not the pure elementary† fire in the second or philosophic sense, such as was understood by the sages of antiquity, and such as is collected in the focus of a burning glass; much less is it the vis, force, or power of burning, destroying, calcining, melting, vitrifying, and raising the perceptions of light and heat. This is truly and really in the incorporeal agent, and not in the vital spirit of the universe. Motion and even power in an equivocal sense may be found in this pure ethereal spirit, which ignites bodies, but is not itself the ignited body, being an instrument or medium‡ by which the real agent doth operate on grosser bodies.

* Sect. 153, 156, 157. † Sect. 190. ‡ Sect. 160.

222. It hath been shown in Sir Isaac's Newton's Optics, that light is not reflected by impinging on bodies, but by some other course. And to him it seems probable, that as many rays as impinge on the solid parts of bodies are not reflected, but stifled and retained in the bodies. And it is certain, the great porosity of all known bodies affords room for much of this light or fire to be lodged therein. Gold itself the most solid of all metals, seems to have far more pores than solid parts, from water being pressed through it in the Florentine experiment, from magnetic effluvia passing, and from mercury entering its pores so freely. And it is admitted that water, though impossible to be compressed, hath at least forty times more pores than solid parts. And as acid particles, joined with those of earth in certain proportions, are so closely united with them, as to be quite hid and lost to all appearance, as in *mercurius dulcis* and common sulphur, so also may we conceive the particles of light or fire to be absorbed and latent in grosser bodies.

223. It is the opinion of Sir Isaac Newton, that somewhat unknown remains in vacuo, when the air is exhausted. This unknown medium he calls ether. He supposeth it to be more subtile in its nature, and more swift in its motion than light, freely to pervade all bodies, and by its immense elasticity to be expanded throughout all the heavens. Its density is supposed greater in free and open spaces, than within the pores of compact bodies. And, in passing from the celestial bodies to great distances, it is supposed to grow denser and denser continually; and thereby cause those great bodies to gravitate towards one another, and their respective parts towards their centres, every body endeavouring to pass from the denser parts of the medium towards the rarer.

224. The extreme minuteness of the parts of this medium and the velocity of their motion, together with its gravity, density, and elastic force, are thought to qualify it for being the cause of all the natural motions in the universe. To this cause are ascribed the gravity and cohesion of bodies. The refraction of light is also thought to proceed from the different density and elastic force of this ethereal medium in different places. The vibrations of this medium alternately concurring with, or obstructing the motions of the rays of light, are supposed to produce the fits of easy reflection and transmission. Light by the vibrations of this medium is thought to communicate heat to bodies. Animal motion and sensation are also accounted for by the vibrating motions of this ethereal medium, propagated through the solid capillaments of the nerves. In a word, all the phenomena and properties of bodies, that were before attributed to attraction, upon later thoughts seem ascribed to this ether, together with the various attractions themselves.

225. But in the philosophy of Sir Isaac Newton, the fits (as they are called) of easy transmission and reflection, seem as well accounted for by vibrations excited in bodies by the rays of light; and the refraction of light by the attraction of bodies. To explain the vibrations of light by those of a more subtile medium, seems an uncouth explication. And gravity seems not an effect of the density and elasticity of ether, but rather to be produced by some other cause; which Sir Isaac himself insinuates, to have been the opinion even of those ancients who took vacuum, atoms, and the gravity of atoms, for the principles of their philosophy, tacitly attributing (as he well observes) gravity to have some other cause distinct from matter, from atoms, and consequently, from that homogeneous ether or elastic fluid. The elasticity of which fluid is supposed to depend upon, to be defined and measured by its density; and this by the quantity of matter in one particle, multiplied by the number of particles contained in a given space; and the quantity of matter in any one particle to be determined by its gravity. Should not therefore gravity seem the original property and first supposed? On the other hand, if force be considered as prescinded from gravity and matter, and as existing only in points or centres, what can this amount to but an abstract spiritual incorporeal force?

226. It doth not seem necessary, from the phenomena, to suppose any medium more active and subtile than light or fire. Light being allowed to move at the rate of about ten millions of miles in a minute, what occasion is there to conceive another medium of still smaller and more moveable parts. Light or fire seem the same with ether. So the ancients understood, and so the Greek word implies. It pervades all things,* is every where present. And this same subtile medium according to its various quantities, motions, and determinations, showeth itself in different effects or appearances, and is ether, light, or fire.

227. The particles of ether fly asunder with the greatest force, therefore, when united they must (according to the Newtonian doctrine) attract each other with the greatest force; therefore they are acids,† or constitute the acid; but this united with earthy parts maketh alkali, as Sir Isaac teacheth in his tract *De Acido;* alkali, as appears in cantharides and lixivial salts, is a caustic; caustics are fire; therefore acid is fire; therefore ether is fire; and if fire, light. We are not, therefore, obliged to admit a new medium distinct from light, and of a finer and more exquisite substance, for the explication of phenomena, which appear to be as well explained without it. How can the density or elasticity of ether account for the rapid flight of a ray of light from the sun, still swifter as it goes further from the sun? or how

* Sect. 157. † Sect. 130.

can it account for the various motions and attractions of different bodies? Why oil and water, mercury and iron repel, or why other bodies attract each other? or why a particle of light should repel on one side and attract on the other, as in the case of the islandic crystal? To explain cohesion by hamate atoms is accounted *ignotum per ignotius.* And is it not as much so to account for the gravity of bodies by the elasticity of ether?

228. It is one thing to arrive at general laws of nature from a contemplation of the phenomena, and another to frame an hypothesis, and from thence deduce the phenomena. Those who suppose epicycles, and by them explain the motions and appearances of the planets, may not therefore be thought to have discovered principles true in fact and nature. And albeit we may from the premises infer a conclusion, it will not follow that we can argue reciprocally, and from the conclusion infer the premises. For instance, supposing an elastic fluid, whose constituent minute particles are equidistant from each other and of equal densities and diameters, and recede one from another with a centrifugal force which is inversely as the distance of the centers, and admitting that from such supposition it must follow, that the density and elastic force of such fluid are in the inverse proportion of the space it occupies when compressed by any force; yet we cannot reciprocally infer, that a fluid endued with this property must therefore consist of such supposed equal particles; for it would then follow, that the constituent particles of air were of equal densities and diameters; whereas it is certain, that air is an heterogeneous mass, containing in its composition an infinite variety of exhalations, from the different bodies which make up this terraqueous globe.

229. The phenomena of light, animal spirit, muscular motion, fermentation, vegetation, and other natural operations, seem to require nothing more than the intellectual and artificial fire of Heraclitus, Hippocrates, the Stoics,* and other ancients. Intellect, superadded to ethereal spirit, fire, or light, moves, and moves regularly, proceeding, in a method, as the Stoics, or increasing and diminishing by measure, as Heraclitus expressed it. The Stoics held that fire comprehended and included the spermatic reasons or forms (λόγους σπερματικοὺς) of all natural things. As the forms of things have their ideal existence in the intellect, so it should seem that seminal principles have their natural existence in the light,† a medium consisting of heterogeneous parts, differing from each other in divers qualities that appear to sense, and not improbably having many original properties, attractions, repulsions and motions, the laws and natures whereof are indiscernible to us, otherwise than in their remote effects. And this animated heterogeneous fire should seem a

* Sect. 166, 168. † Sect. 164.

more adequate cause, whereby to explain the phenomena of nature, than one uniform ethereal medium.

230. Aristotle indeed excepts against the elements being animated. Yet nothing hinders why that power of the soul, styled by him κινητικὴ, or locomotive, may not reside therein, under the direction of an intellect, in such sense and as properly as it is said to reside in animal bodies. It must nevertheless be owned, that albeit that philosopher acknowledgeth a divine force or energy in fire, yet to say that fire is alive, or that having a soul it should not be alive, seem to him equally absurd. See his second book *De Partibus Animalium*.

231. The laws of attraction and repulsion are to be regarded as laws of motion, and these only as rules or methods observed in the productions of natural effects, the efficient and final causes whereof are not of mechanical consideration. Certainly, if the explaining a phenomenon be to assign its proper efficient and final cause,* it should seem the mechanical philosophers never explained any thing; their province being only to discover the laws of nature, that is, the general rules and methods of motion, and to account for particular phenomena by reducing them under, or showing their conformity to such general rules.

232. Some corpuscularian philosophers of the last age, have indeed attempted to explain the formation of this world and its phenomena, by a few simple laws of mechanism. But if we consider the various productions of nature, in the mineral, vegetable, and animal parts of the creation, I believe we shall see cause to affirm, that not any one of them has hitherto been, or can be accounted for on principles merely mechanical; and that nothing could be more vain or imaginary, than to suppose with Descartes, that merely from a circular motion's being impressed by the supreme agent on the particles of extended substance, the whole world with all its several parts, appurtenances, and phenomena might be produced, by a necessary consequence, from the laws of motion.

233. Others suppose that God did more at the beginning, having then made the seeds of all vegetables and animals, containing their solid organical parts in miniature, the gradual filling and evolution of which, by the influx of proper juices, doth constitute the generation and growth of a living body. So that the artificial structure of plants and animals daily generated, requires no present exercise of art to produce it, having been already framed at the origin of the world, which with all its parts hath ever since subsisted, going like a clock or machine by itself, according to the laws of nature, without the immediate hand of the artist. But how can this hypothesis explain the blended features of different species in mules and other mongrels?

* Sect. 154, 155, 160.

or the parts added or changed, and sometimes whole limbs lost by marking in the womb? or how can it account for the resurrection of a tree from its stump, or the vegetative power in its cuttings? in which cases we must necessarily conceive something more than the mere evolution of a seed.

234. Mechanical laws of nature or motion direct us how to act, and teach us what to expect. Where intellect presides there will be method and order, and therefore rules, which if not stated and constant would cease to be rules. There is therefore a constancy in things, which is styled the course of nature.* All the phenomena in nature are produced by motion. There appears a uniform working in things great and small, by attracting and repelling forces. But the particular laws of attraction and repulsion are various. Nor are we concerned at all about the forces, neither can we know or measure them otherwise than by their effects, that is to say, the motions, which motions only, and not the forces, are indeed in the bodies.† Bodies are moved to or from each other, and this is performed according to different laws. The natural or mechanic philosopher endeavours to discover those laws by experiment and reasoning. But what is said of forces residing in bodies, whether attracting or repelling, is to be regarded only as a mechanical hypothesis, and not as any thing really existing in nature.

235. We are not therefore seriously to suppose, with certain mechanic philosophers, that the minute particles of bodies have real forces or powers, by which they act on each other, to produce the various phenomena in nature. The minute corpuscles are impelled and directed, that is to say, moved to and from each other according to various rules or laws of motion. The laws of gravity, magnetism, and electricity, are divers. And it is not known, what other different rules or laws of motion might be established, by the Author of nature. Some bodies approach together, others fly asunder, and perhaps some others do neither. When salt of tartar flows *per deliquium*, it is visible that the particles of water floating in the air are moved towards the particles of salt, and joined with them. And when we behold vulgar salt not to flow *per deliquium*, may we not conclude that the same law of nature and motion doth not obtain between its particles and those of the floating vapours? A drop of water assumes a round figure, because its parts are moved towards each other. But the particles of oil and vinegar have no such disposition to unite. And when flies walk in water without wetting their feet, it is attributed to a repelling force or faculty in the fly's feet. But this is obscure, though the phenomenon be plain.

236. It is not improbable, and seems not unsupported by experiments, that, as in algebra, where positive quantities cease

* Sect. 160. † Sect. 155.

there negative begin, even so in mechanics, where attracting forces cease there repelling forces begin: or, to express it more properly, where bodies cease to be moved towards, they begin to be moved from each other. This Sir Isaac Newton infers from the production of air and vapours, whose particles fly asunder with such vehement force. We behold iron move towards the loadstone, straws towards amber, heavy bodies towards the earth. The laws of these motions are various. And when it is said, that all the motions and changes in the great world arise from attraction, the elasticity of the air, the motion of water, the descent of heavy, and the ascent of light bodies, being all ascribed to the same principle; when from insensible attractions of most minute particles at the smallest distance, are derived cohesion, dissolution, coagulation, animal secretion, fermentation, and all chymical operations; and when it is said, that without such principles there never would have been any motion in the world, and without the continuance thereof all motion would cease. In all this we know or understand no more, than that bodies are moved according to a certain order, and that they do not move themselves.

237. So likewise, how to explain all those various motions and effects by the density and elasticity of ether seems incomprehensible.* For instance, why should the acid particles draw those of water and repel each other? Why should some salts attract vapours in the air, and others not? Why should the particles of common salt repel each other, so as not to subside in water? Why should the most repellent particles be the most attractive upon contact? Or, why should the repellent begin where the attractive faculty leaves off? These, and numberless other effects seem inexplicable on mechanical principles, or otherwise than by recourse to a mind or spiritual agent.† Nor will it suffice from present phenomena and effects, through a chain of natural causes, and subordinate blind agents, to trace a divine intellect as the remote original cause, that first created the world, and then set it a-going. We cannot make even one single step in accounting for the phenomena, without admitting the immediate presence and immediate action of an incorporeal agent, who connects, moves, and disposes all things, according to such rules and for such purposes as seem good to him.

238. It is an old opinion adopted by the moderns, that the elements and other natural bodies are changed each into other.‡ Now, as the particles of different bodies are agitated by different forces, attracting and repelling, or, to speak more accurately, are moved by different laws, how can these forces or laws be changed, and this change accounted for, by an elastic ether? Such a medium distinct from light or fire seemeth not to be made out by

* Sect. 153, 162. † Sect. 154, 220. ‡ Sect. 148.

any proof, nor to be of any use in explaining the phenomena. But if there be any medium employed, as a subordinate cause or instrument in attraction, it would rather seem to be light;* since by an experiment of Mr. Boyle's, amber, that showed no sign of attraction in the shade, being placed where the sun-beams shone upon it, immediately attracted light bodies. Besides, it hath been discovered by Sir Isaac Newton, and an admirable discovery it was, that light is an heterogeneous medium,† consisting of particles endued with original distinct properties. And upon these, if I may venture to give my conjectures, it seemeth probable the specific properties of bodies, and the force of specific medicines may depend. Different sides of the same ray shall, one approach and the other recede from the islandic crystal; can this be accounted for by the elasticity of a fine medium, or by the general laws of motion, or by any mechanical principles whatever? And if not, what should hinder but there may be specific medicines, whose operation depends not upon mechanical principles, how much soever that notion hath been exploded of late years.

239. Why may we not suppose certain idiosyncrasies, sympathies, oppositions, in the solids or fluids, or animal spirit of a human body, with regard to the fine insensible parts of minerals or vegetables, impregnated by rays of light of different properties, not depending on the different size, figure, number, solidity or weight of those particles, nor on the general laws of motion, nor on the density or elasticity of a medium, but merely and altogether on the good pleasure of the Creator, in the original formation of things? From whence divers unaccountable and unforeseen motions may arise in the animal economy; from whence also various peculiar and specific virtues may be conceived to arise, residing in certain medicines, and not to be explained by mechanical principles. For although the general known laws of motion are to be deemed mechanical, yet peculiar motions of the insensible parts, and peculiar properties depending thereon, are occult and specific.

240. The words attraction and repulsion may, in compliance with custom, be used where, accurately speaking, motion alone is meant. And in that sense it may be said, that peculiar attractions or repulsions in the parts, are attended with specific properties in the whole. The particles of light are vehemently moved to or from, retained or rejected by objects. Which is the same thing as to say, with Sir Isaac Newton, that the particles of acids are endued with great attractive force,‡ wherein their activity consists; whence fermentation and dissolution; and that the most repellent are, upon contact, the most attracting particles.

241. Gravity and fermentation are received for two most ex-

* Sect. 152, 156. † Sect. 40, 181. ‡ Sect. 202.

tensive principles. From fermentation are derived the motion and warmth of the heart and blood in animals, subterraneous heat, fires, and earthquakes, meteors and changes in the atmosphere. And, that attracting and repelling forces operate in the nutrition and dissolution of animal and vegetable bodies, is the doctrine both of Hippocrates and Sir Isaac Newton. The former of these celebrated authors, in his treatise concerning diet or regimen, observes that in the nourishment of man, one part repels and another attracts. And again in the same treatise, two carpenters, saith he, saw a piece of timber: one draws, the other pushes: these two actions tend to one and the same end, though in a contrary direction, one up, the other down: this imitates the nature of man: πνεῦμα τὸ μὲν ἕλκει τὸ δὲ ὠθέει.

242. It is the general maxim of Hippocrates, that the manner wherein nature acts consisteth in attracting what is meet and good, and in repelling what is disagreeable or hurtful. He makes the whole of the animal economy to be administered by the faculties or powers of nature. Nature alone, saith he, sufficeth for all things to animals. She knows of herself what is necessary for them. Whence it is plain, he means a conscious intelligent nature, that presides and moves the ethereal spirit. And though he declares all things are accomplished on man by necessity, yet it is not a blind fate or chain of mere corporeal causes, but a divine necessity, as he himself expressly calls it. And what is this but an overruling intelligent power that disposeth of all things?

243. Attraction cannot produce, and in that sense account for the phenomena, being itself one of the phenomena produced and to be accounted for.* Attraction is performed by different laws, and cannot therefore in all cases be the effect of the elasticity of one uniform medium. The phenomena of electrical bodies, the laws and variations of magnetism, and, not to mention other kinds, even gravity, is not explained by elasticity, a phenomenon not less obscure than itself. But then, although it show not the agent, yet it showeth a rule and analogy in nature, to say, that the solid parts of animals are endued with attractive powers whereby from contiguous fluids they draw like to like; and that glands have peculiar powers attractive of peculiar juices.† Nature seems better known and explained by attractions and repulsions, than by those other mechanical principles of size, figure, and the like: that is, by Sir Isaac Newton, than Descartes. And natural philosophers excel, as they are more or less acquainted with the laws and methods observed by the author of nature.

244. The size and shape of particles and general laws of motion can never explain the secretions without the help of attraction, obscure perhaps as to its cause, but clear as a law.

* Sect 160, 235. † Sect. 41.

Numberless instances of this might be given: Lemery the younger thought himself obliged to suppose, the particles of light or fire (contrary to all reason) to be of a very gross kind, even greater than the pores of the burnt limestone, in order to account for their being detained or imprisoned therein; but this phenomenon is easily reduced to attraction. There would be no end of enumerating the like cases. The activity and force of ethereal spirit or fire by the laws of attraction, is imparted to grosser particles,* and thereby wonderfully supports the economy of living bodies. By such peculiar compositions and attractions it seems to be effected, that denser fluids can pass where air itself cannot, (as oil through leather) and therefore through the nicest and finest strainers of an animal or vegetable.

245. The ancients had some general conception of attracting and repelling powers† as natural principles. Galilæi had particularly considered the attraction of gravity, and made some discovery of the laws thereof. But Sir Isaac Newton by his singular penetration, profound knowledge in geometry and mechanics, and great exactness in experiments, hath cast a new light on natural science. The laws of attraction and repulsion were in many instances discovered, and first discovered by him. He showed their general extent, and therewith as with a key opened several deep secrets of nature, in the knowledge whereof he seems to have made a greater progress, than all the sects of corpuscularians together had done before him. Nevertheless, the principle of attraction itself is not to be explained by physical or corporeal causes.

246. The Cartesians attempted to explain it by the nisus of a subtile element, receding from the center of its motion, and impelling grosser bodies towards it. Sir Isaac Newton in his later thoughts seems (as was before observed) to have adopted somewhat not altogether foreign from this notion, ascribing that to his elastic medium‡ which Descartes did to his second element. But the great men of antiquity resolved gravity into the immediate action of an intelligent incorporeal being. To which also Sir Isaac Newton himself attests and subscribes, although he may perhaps sometimes be thought to forget himself, in his manner of speaking of physical agents, which in a strict sense are none at all; and in supposing real forces to exist in bodies, in which, to speak truly, attraction and repulsion should be considered only as tendencies or motions, that is, as mere effects, and their laws as laws of motion.

247. Though it be supposed the chief business of a natural philosopher to trace out causes from the effects, yet this is to be understood not of agents§ but of principles, that is of component

* Sect. 152, 163. † Sect. 241, 242. ‡ Sect. 237, 238. § Sect. 155.

parts, in one sense, or of laws or rules in another. In strict truth, all agents are incorporeal, and as such are not properly of physical consideration. The astronomer, therefore, the mechanic, or the chymist, not as such, but by accident only, treat of real causes, agents, or efficients. Neither doth it seem, as is supposed by the greatest of mechanical philosophers, that the true way of proceeding in their science is, from known motions in nature to investigate the moving forces. Forasmuch as force is neither corporeal nor belongs to any corporeal thing;* nor yet to be discovered by experiments or mathematical reasonings, which reach no further than discernible effects, and motions in things passive and moved.

248. Vis or force is to the soul what extension is to the body, saith St. Augustin, in his tract concerning the quantity of the soul; and without force there is nothing done or made, and consequently there can be no agent. Authority is not to decide in this case. Let any one consult his own notions and reason, as well as experience, concerning the origin of motion, and the respective natures, properties, and differences of soul and body, and he will, if I mistake not, evidently perceive, that there is nothing active in the latter. Nor are they natural agents or corporeal forces, which make the particles of bodies to cohere. Nor is it the business of experimental philosophers to find them out.

249. The mechanical philosopher, as hath been already observed, inquires properly concerning the rules and modes of operation alone, and not concerning the cause, forasmuch as nothing mechanical is or really can be a cause.† And although a mechanical or mathematical philosopher may speak of absolute space, absolute motion, and of force as existing in bodies, causing such motion and proportional thereto; yet what these forces are, which are supposed to be lodged in bodies, to be impressed on bodies, to be multiplied, divided, and communicated from one body to another, and which seem to animate bodies like abstract spirits, or souls, hath been found very difficult, not to say impossible, for thinking men to conceive and explain, as may be seen by consulting Borellus *De Vi Percussionis*, and Torricelli in his *Lezioni Academiche*, among other authors.

250. Nor, if we consider the proclivity of mankind to realize their notions, will it seem strange that mechanic philosophers and geometricians should, like other men, be misled by prejudice, and take mathematical hypotheses for real beings existing in bodies, so far as even to make it the very aim and end of their science to compute or measure those phantoms; whereas it is very certain that nothing in truth can be measured‡ or computed, besides the very effects or motions themselves. Sir Isaac

* Sect. 220. † Sect. 236, 247.

‡ This subject is handled at large in the Treatise concerning Motion.

Newton asks, Have not the minute particles of bodies certain forces or powers by which they act on one another, as well as on the particles of light, for producing most of the phenomena in nature? But in reality, those minute particles are only agitated according to certain laws of nature, by some other agent, wherein the force exists and not in them, which have only the motion; which motion in the body moved, the Peripatetics rightly judge to be a mere passion, but in the mover to be ἐνέργεια, or act.

251. It passeth with many, I know not how, that mechanical principle, give a clear solution of the phenomena. The Democritic hypothesis, saith Dr. Cudworth, doth much more handsomely and intelligibly solve the phenomena, than that of Aristotle and Plato. But things rightly considered, perhaps it will be found not to solve any phenomenon at all. For all phenomena are, to speak truly, appearances in the soul and mind, and it hath never been explained, nor can it be explained, how external bodies, figures, and motion, should produce an appearance in the mind. These principles, therefore, do not solve, if by solving is meant assigning the real, either efficient or final cause of appearances, but only reduce them to general rules.

252. There is a certain analogy, constancy, and uniformity in the phenomena or appearances of nature, which are a foundation for general rules, and these are a grammar for the understanding of nature, or that series of effects in the visible world, whereby we are enabled to foresee what will come to pass, in the natural course of things. Plotinus observes, in his third Æneid, that the art of presaging is in some sort the reading of natural letters denoting order, and that so far forth as analogy obtains in the universe, there may be vaticination. And in reality, he that foretells the motions of the planets, or the effects of medicines, or the results of chymical or mechanical experiments, may be said to do it by natural vaticination.

253. We know a thing when we understand it: and we understand it, when we can interpret or tell what it signifies. Strictly the sense knows nothing. We perceive indeed sounds by hearing and characters by sight; but we are not therefore said to understand them. After the same manner, the phenomena of nature are alike visible to all; but all have not alike learned the connexion of natural things, or understand what they signify, or know how to vaticinate by them. There is no question, saith Socrates, in Theæteto, concerning that which is agreeable to each person; but concerning what will in time to come be agreeable, of which all men are not equally judges. He who foreknoweth what will be in every kind is the wisest. According to Socrates, you and the cook may judge of a dish on the table equally well, but while the dish is making, the cook can better foretell what

will ensue from this or that manner of composing it. Nor is this manner of reasoning confined only to morals or politics; but extends also to natural science.

254. As the natural connexion of signs with the things signified is regular and constant, it forms a sort of rational discourse* and is therefore the immediate effect of an intelligent cause. This is agreeable to the philosophy of Plato and other ancients. Plotinus indeed saith, that which acts naturally is not intellection, but a certain power of moving matter, which doth not know but only do. And it must be owned, that as faculties are multiplied by philosophers according to their operations, the will may be distinguished from the intellect. But it will not therefore follow, that the will, which operates in the course of nature, is not conducted and applied by intellect, although it be granted that neither will understands, nor intellect wills. Therefore, the phenomena of nature, which strike on the senses and are understood by the mind, do form not only a magnificent spectacle, but also a most coherent, entertaining, and instructive discourse; and to effect this, they are conducted, adjusted, and ranged by the greatest wisdom. This language or discourse is studied with different attention, and interpreted with different degrees of skill. But so far as men have studied and remarked its rules, and can interpret right, so far they may be said to be knowing in nature. A beast is like a man who hears a strange tongue, but understands nothing.

255. Nature, saith the learned Dr. Cudworth, is not master of art or wisdom: nature is *ratio mersa et confusa*, reason immerged and plunged into matter, and as it were fuddled in it and confounded with it. But the formation of plants and animals, the motions of natural bodies, their various properties, appearances, and vicissitudes, in a word, the whole series of things in this visible world which we call the course of nature, is so wisely managed and carried on, that the most improved human reason cannot thoroughly comprehend even the least particle thereof; so far is it from seeming to be produced by fuddled or confounded reason.

256. Natural productions, it is true, are not all equally perfect. But neither doth it suit with the order of things, the structure of the universe, or the ends of Providence, that they should be so. General rules, we have seen,† are necessary to make the world intelligible: and from the constant observations of such rules, natural evils will sometimes unavoidably ensue: things will be produced in a slow length of time, and arrive at different degrees of perfection.

257. It must be owned, we are not conscious of the systole and diastole of the heart, or the motion of the diaphragm. It

* Sect. 152. † Sect. 249, 252.

may not nevertheless be thence inferred, that unknowing nature can act regularly, as well as ourselves. The true inference is, that the self-thinking individual, or human person, is not the real author of those natural motions. And in fact no man blames himself if they are wrong, or values himself if they are right. The same may be said of the fingers of a musician, which some object to be moved by habit which understands not; it being evident, that what is done by rule must proceed from something that understands the rule, therefore, if not from the musician himself, from some other active intelligence, the same perhaps which governs bees and spiders, and moves the limbs of those who walk in their sleep.

258. Instruments, occasions, and signs* occur in, or rather make up, the whole visible course of nature. These, being no agents themselves, are under the direction of one agent concerting all for one end, the supreme good. All those motions, whether in animal bodies or in other parts of the system of nature, which are not effects of particular wills, seem to spring from the same general cause with the vegetation of plants, an ethereal spirit actuated by a mind.

259. The first poets and theologers of Greece and the East considered the generation of things, as ascribed rather to a divine cause, but the Physici to natural causes subordinate to, and directed still by a divine; except some corporealists and mechanics who vainly pretended to make a world without a God. The hidden force that unites, adjusts, and causeth all things to hang together, and move in harmony, which Orpheus and Empedocles styled love; this principle of union is no blind principle, but acts with intellect. This divine love and intellect are not themselves obvious to our view, or otherwise discerned than in their effects. Intellect enlightens, love connects, and the sovereign good attracts all things.

260. All things are made for the supreme good, all things tend to that end: and we may be said to account for a thing, when we show that it is so best. In the Phædon, Socrates declares it to be his opinion, that he who supposed all things to have been disposed and ordered by a mind,† should not pretend to assign any other cause of them. He blames physiologists for attempting to account for phenomena, particularly for gravity and cohesion, by vortexes and ether, overlooking the τὸ ἀγαθὸν and τὸ δέον, the strongest bond and cement which holds together all the parts of the universe, and not discerning the cause itself from those things which only attend it.

261. As in the microcosm, the constant regular tenor of the motions of the viscera and contained juices, doth not hinder particular voluntary motions to be impressed by the mind on the

* Sect. 160. † Sect. 154, 160.

animal spirit, even so in the mundane system, the steady observance of certain laws of nature, in the grosser masses and more conspicuous motions, doth not hinder but a voluntary agent may sometimes communicate particular impressions to the fine ethereal medium, which in the world answers the animal spirit in man. Which two (if they are two), although invisible and inconceivably small, yet seem the real latent springs whereby all the parts of this visible world are moved; albeit they are not to be regarded as a true cause, but only an instrument of motion; and the instrument not as a help to the Creator, but only as a sign to the creature.

262. Plotinus supposeth that the soul of the universe is not the original cause or author of the species, but receives them from intellect, the true principle of order and distinction, the source and giver of forms. Others consider the vegetative soul only as some lower faculty of a higher soul, which animates the fiery ethereal spirit.* As for the blots and defects which appear in the course of this world, which some have thought to proceed from a fatality or necessity in nature, and others from an evil principle, that same philosopher observes, that it may be the governing reason produceth and ordaineth all those things; and, not intending that all parts should be equally good, maketh some worse than others by design, as all parts in an animal are not eyes: and in a city, comedy, or picture, all ranks, characters, and colours are not equal or alike; even so excesses, defects, and contrary qualities, conspire to the beauty and harmony of the world.

263. It cannot be denied, that with respect to the universe of things, we in this mortal state are like men educated in Plato's cave, looking on shadows with our backs turned to the light. But though our light be dim, and our situation bad, yet if the best use be made of both, perhaps something may be seen. Proclus, in his commentary on the theology of Plato, observes there are two sorts of philosophers. The one placed body first in the order of beings, and made the faculty of thinking depend thereupon, supposing that the principles of all things are corporeal: that body most really or principally exists, and all other things in a secondary sense, and by virtue of that. Others, making all corporeal things to be dependent upon soul or mind, think this to exist in the first place and primary sense, and the being of bodies to be altogether derived from and presuppose that of the mind.

264. Sense and experience acquaint us with the course and analogy of appearances or natural effects. Thought, reason, intellect, introduce us into the knowledge of their causes. Sensible appearances, though of a flowing, unstable, and uncertain

* Sect. 178.

nature, yet having first occupied the mind, they do by an early prevention, render the after task of thought more difficult; and, as they amuse the eyes and ears, and are more suited to vulgar uses and the mechanic arts of life, they easily obtain the preference, in the opinion of most men, to those superior principles which are the later growth of the human mind arrived to maturity and perfection, but, not affecting the corporeal sense, are thought to be so far deficient in point of solidity and reality, sensible and real to common apprehensions being the same thing. Although it be certain, that the principles of science are neither objects of sense nor imagination, and that intellect and reason are alone the sure guides to truth.

265. The successful curiosity of the present age in arts, and experiments, and new systems, is apt to elate men, and make them overlook the ancients. But, notwithstanding that the encouragement and purse of princes, and the united endeavours of great societies in these later ages, have extended experimental and mechanical knowledge very far, yet it must be owned, that the ancients, too, were not ignorant of many things,* as well in physics as metaphysics, which perhaps are more generally, though not first, known in these modern times.

266. The Pythagoreans and Platonists had a notion of the true system of the world. They allowed of mechanical principles, but actuated by soul or mind; they distinguished the primary qualities in bodies from the secondary, making the former to be physical causes, and they understood physical causes in a right sense: they saw that a mind infinite in power, unextended, invisible, immortal, governed, connected, and contained all things: they saw there was no such thing as real, absolute space: that mind, soul, or spirit, truly and really exists: that bodies exist only in a secondary and dependent sense: that the soul is the place of forms: that the sensible qualities are to be regarded as acts only in the cause, and as passions in us. They accurately considered the differences of intellect, rational soul, and sensitive soul, with their distinct acts of intellection, reasoning, and sensation, points wherein the Cartesians and their followers, who consider sensation as a mode of thinking, seem to have failed. They knew there was a subtile ether pervading the whole mass of corporeal beings, and which was itself actually moved and directed by a mind: and that physical causes were only instruments, or rather marks and signs.

267. Those ancient philosophers understood the generation of animals to consist in the unfolding and distending of the minute, imperceptible parts of pre-existing animalcules, which passeth for a modern discovery: this they took for the work of nature, but nature animate and intelligent.† They understood that all things

* Sect. 166, 167, 168, 241, 242, &c. † Sect. 172.

were alive and in motion. They supposed a concord and discord, union and disunion, in particles, some attracting, others repelling each other: and that those attractions and repulsions, so various, regular, and useful, could not be accounted for but by an intelligence presiding and directing all particular motions, for the conservation and benefit of the whole.

268. The Egyptians, who impersonated nature, had made her a distinct principle, and even deified her under the name of Isis. But Osiris was understood to be mind, or reason, chief and sovereign of all. Osiris, if we may believe Plutarch, was the first pure, unmixed, and holy principle, not discernible by the lower faculties; a glimpse whereof, like lightning darting forth, irradiates the understanding; with regard to which Plutarch adds, that Plato and Aristotle termed one part of philosophy ἐποπτικὸν, to wit, when having soared above common mixed objects, and got beyond the precincts of sense and opinion, they arrive to contemplate the first and most simple being, free from all matter and composition. This is that ὀυσία ὄντως οὖσα of Plato which employeth mind alone, which alone governs the soul. And the soul is that which immediately informs and animates nature.

269. Although the Egyptians did symbolically represent the supreme divinity sitting on a lotus, and that gesture hath been interpreted to signify, the most holy and venerable being to be utterly at rest reposing within himself: yet, for any thing that appears, this gesture might denote dignity as well as repose. And it cannot be denied, that Jamblichus, so knowing in the Egyptian notions, taught there was an intellect that proceeded to generation, drawing forth the latent powers into light in the formation of things. Nor was this to be understood of an external world, subsisting in real absolute space; for it was a doctrine of those ancient sages, that soul was the place of forms, as may be seen in the twelfth book of the arcane part of divine wisdom, according to the Egyptians. This notion was embraced by divers philosophers of Greece, who may be supposed to have derived it from the same source, from whence many of their other opinions were drawn.

270. The doctrine of real absolute external space, induced some modern philosophers to conclude it was a part or attribute of God, or that God himself was space; inasmuch as incommunicable attributes of the deity appeared to agree thereto, such as infinity, immutability, indivisibility, incorporeity, being uncreated, impassive, without beginning or ending; not considering that all these negative properties may belong to nothing. For nothing hath no limits, cannot be moved or changed, or divided, is neither created nor destroyed. A different way of thinking appears in the Hermaic as well as other writings of the ancients. With re-

gard to absolute space, it is observed in the Asclepian dialogue; that the word space or place hath by itself no meaning; and again, that it is impossible to understand what space alone or pure space is. And Plotinus acknowledgeth no place, but soul or mind, expressly affirming that the soul is not in the world, but the world in the soul. And farther, the place of the soul, saith he, is not body, but soul is in mind, and body in soul. See the third chapter of the fifth book of the fifth Æneid.

271. Concerning absolute space, that phantom of the mechanic geometrical philosophers,* it may suffice to observe, that it is neither perceived by any sense, nor proved by any reason, and was accordingly treated by the greatest of the ancients as a thing merely visionary. From the notion of absolute space springs that of absolute motion;† and in these are ultimately founded the notions of eternal existence, independence, necessity, and fate. Which fate, the idol of many moderns, was by old philosophers differently understood, and in such a sense as not to destroy the αὐτεξούσιον of God or man. Parmenides, who thought all things to be made by necessity or fate, understood justice and providence to be the same with fate; which, how fixed and cogent soever with respect to man, may yet be voluntary with respect to God. Empedocles declared fate to be a cause using principles and elements. Heraclitus taught that fate was the reason that runs through the whole nature of the universe: which general nature he supposed to be an ethereal body, the seed of the generation of all things. Plato held fate to be the eternal reason or law of nature. Chrysippus supposed that fate was a spiritual power which disposed the world in order; that it was the reason and law of those things which are administered by providence.

272. All the foregoing notions of fate, as represented by Plutarch, do plainly show that those ancient philosophers did not mean by fate, a blind, headlong, unintelligent principle, but an orderly settled course of things conducted by a wise and provident mind. And as for the Egyptian doctrine, it is indeed asserted in the Pimander, that all things are produced by fate. But Jamblichus, who drew his notions from Egypt, affirms that the whole of things is not bound up in fate; but that there is a principle of the soul higher than nature, whereby we may be raised to an union with the Gods, and exempt ourselves from fate. And in the Asclepian dialogue it is expressly said, that fate follows the

* Sect. 250.

† Our judgment in these matters is not to be overborne by a presumed evidence of mathematical notions and reasonings, since it is plain, the mathematicians of this age embrace obscure notions and uncertain opinions, and are puzzled about them, contradicting each other and disputing like other men: witness their doctrine of fluxions, about which within these ten years I have seen published above twenty tracts and dissertations, whose authors being utterly at variance, and inconsistent with each other, instruct bystanders what to think of their pretensions to evidence.

decrees of God. And indeed, as all the motions in nature are evidently the product of reason,* it should seem there is no room for necessity, in any other sense than that of a steady regular course.

273. Blind fate and blind chance are at bottom much the same thing, and one no more intelligible than the other. Such is the mutual relation, connection, motion, and sympathy of the parts of this world, that they seem as it were animated and held together by one soul: and such is their harmony, order, and regular course, as showeth the soul to be governed and directed by a mind. It was an opinion of remote antiquity that the world was an animal.† If we may trust the Hermaic writings, the Egyptians thought all things did partake of life. This opinion was also so general and current among the Greeks, that Plutarch asserts all others held the world to be an animal, and governed by providence, except Leucippus, Democritus, and Epicurus. And although an animal, containing all bodies within itself, could not be touched or sensibly affected from without; yet it is plain they attributed to it an inward sense and feeling, as well as appetites and aversions; and that from all the various tones, actions, and passions of the universe, they supposed one symphony, one animal act and life to result.

274. Jamblichus declares the world to be one animal, in which the parts however distant from each other, are nevertheless related and connected by one common nature. And he teacheth, what is also a received notion of the Pythagoreans and Platonics, that there is no chasm in nature, but a chain or scale of beings rising by gentle uninterrupted gradations from the lowest to the highest, each nature being informed and perfected by the participation of a higher. As air becomes igneous, so the purest fire becomes animal, and the animal soul becomes intellectual, which is to be understood not of the change of one nature into another, but of the connection of different natures, each lower nature being, according to those philosophers, as it were a receptacle or subject for the next above it to reside and act in.

275. It is also the doctrine of Platonic philosophers, that intellect is the very life of living things, the first principle and exemplar of all, from whence by different degrees are derived the inferior classes of life: first the rational, then the sensitive, after that the vegetal, but so as in the rational animal, there is still somewhat intellectual, again in the sensitive there is somewhat rational, and in the vegetal somewhat sensitive, and lastly in mixed bodies, as metals and minerals, somewhat of vegetation. By which means the whole is thought to be more perfectly connected. Which doctrine implies that all the faculties, instincts, and motions of inferior beings, in their several respective

* Sect. 154. † Sect. 153, 172.

subordinations, are derived from and depend upon mind and intellect.

276. Both Stoics and Platonics held the world to be alive, though sometimes it be mentioned as a sentient animal, sometimes as a plant or vegetable. But in this, notwithstanding what hath been surmised by some learned men, there seems to be no atheism. For so long as the world is supposed to be quickened by elementary fire or spirit, which is itself animated by soul, and directed by understanding, it follows, that all parts thereof originally depend upon, and may be reduced unto, the same indivisible stem or principle, to wit, a supreme mind; which is the concurrent doctrine of Pythagoreans, Platonics, and Stoics.

277. There is, according to those philosophers, a life infused throughout all things: the πῦρ νοερὸν, πῦρ τεχνικὸν, an intellectual and artificial fire,* an inward principle, animal spirit, or natural life, producing and forming within, as art doth without, regulating, moderating, and reconciling, the various motions, qualities, and parts, of this mundane system. By virtue of this life, the great masses are held together in their ordinary courses, as well as the minutest particles, governed in their natural motions, according to the several laws of attraction, gravity, electricity, magnetism, and the rest. It is this gives instincts, teaches the spider her web, and the bee her honey. This it is that directs the roots of plants to draw forth juices from the earth, and the leaves and corticle vessels to separate and attract such particles of air and elementary fire, as suit their respective natures.

278. Nature seems to be not otherwise distinguished from the *anima mundi*, than as life is from soul; and, upon the principles of the oldest philosophers, may not improperly or incongruously be styled, the life of the world. Some Platonics, indeed, regard life as the act of nature, in like manner as intellection is of the mind or intellect. As the first intellect acts by understanding, so nature, according to them, acts or generates by living. But life is the act of the soul, and seems to be very nature itself, which is not the principle, but the result of another and higher principle, being a life resulting from soul, as cogitation from intellect.

279. If nature be supposed the life of the world, animated by one soul, compacted into one frame, and directed or governed in all parts by one mind, this system cannot be accused of atheism, though perhaps it may of mistake or impropriety. And yet, as one presiding mind gives unity to the infinite aggregate of things, by a mutual communion of actions and passions, and an adjustment of parts, causing all to concur in one view to one

* Sect. 166, 168, 174, 175, &c.

and the same end, the ultimate and supreme good of the whole, it should seem reasonable to say, with Ocellus Lucanus, the Pythagorean, that as life holds together the bodies of animals, the cause whereof is the soul; and as a city is held together by concord, the cause whereof is law; even so the world is held together by harmony, the cause whereof is God. And in this sense, the world or universe may be considered either as one animal * or one city.

280. Aristotle disapproves the opinion of those who hold a soul to be diffused throughout the world, and for this reason, because the elements are not alive. Though perhaps it may not be easy to prove, that blood and animal spirit are more alive in man, than water and fire in the world. That philosopher, in his books of the soul, remarks upon an opinion set forth in the Orphics, of the soul's entering from the universe into living creatures being borne by winds, that this cannot be true of plants, or of certain animals which do not breathe. But air vessels are, by later experiments, allowed to be found in all plants and animals. And air may, in some sort, not improperly be said to be the carrier or vehicle of the soul, inasmuch as it is the vehicle of fire, which is the spirit immediately moved and animated by the soul.†

281. The living fire, the living omniform seminary of the world, and other expressions of the like nature occurring in the ancient and Platonic philosophy, how can they be understood exclusive of light or elemental fire, the particles of which are known to be heterogeneous; and, for ought we know, may some of them be organized, and, notwithstanding their wonderful minuteness, contain original seeds, which, being formed and sowed in a proper matrix, do gradually unfold and manifest themselves, still growing to a just proportion of the species.

282. May not this ethereal seminary, consistently with the notions of that philosophy, which ascribed much of generation to celestial influence, be supposed to impregnate plants and animals with the first principles, the stamina, or those animalcules which Plato, in his Timæus, saith, are invisible for their smallness, but being sown in a proper matrix, are therein gradually distended and explicated by nourishment; and, at length, the animal's brought forth to light. Which notion hath been revived and received of late years by many, who perhaps are not aware of its antiquity, or that it was to be found in Plato. Timæus Locrensis, in his book of the soul of the world, supposeth even souls to be derived from the celestial luminaries, excepting only the rational or intellectual part. But what influence or influx is there from the celestial bodies, which hath not light for its vehicle?‡

* Sect. 172, 277. † Sect. 163, 171. ‡ Sect. 43.

283. What other nature there should be intermediate between the soul of the world* and this gross corporeal system, which might be the vehicle of life; or, to use the language of philosophers, might receive or be impressed with the forms of things, is difficult to comprehend. It is a vulgar remark, that the works of art do not bear a nice microscopial inspection, but the more helps are used, and the more nicely you pry into natural productions, the more do you discover of the fine mechanism of nature, which is endless or inexhaustible; new and other parts, more subtile and delicate than the precedent, still continuing to offer themselves to view. And these microscopial observations have confirmed the ancient theory concerning generation, delivered in the Timæus of Plato. But that theory or hypothesis, how agreeable soever to modern discoveries, is not alone sufficient to explain the phenomena, without the immediate action of a mind. And Ficinus, notwithstanding what he himself and other Platonics say of a plastic nature, is obliged to own, that with the mundane force or soul it is to be understood, there is joined an intelligence, upon which the seminal nature constantly depends, and by which it is governed.

284. Alcinous, in his tract of the doctrine of Plato, saith, that God hath given the world both mind and soul: others include both in the word soul, and suppose the soul of the world to be God. Philo appears to be of this opinion in several parts of his writings. And Virgil, who was no stranger to the Pythagorean and Platonic tenets, writes to the same purpose.

> Deum namque ire per omnes
> Terrasque, tractusque maris, cœlumque profundum.
> Hinc pecudes, armenta, viros, genus omne ferarum,
> Quemque sibi tenues nascentem arcessere vitas.†
>
> GEORGICON, lib. iv. 221.

Thus much the schools of Plato and Pythagoras seem agreed in, to wit, that the soul of the world,‡ whether having a distinct mind of its own, or directed by a superior mind,§ doth embrace all its parts, connect them by an invisible and indissoluble chain, and preserve them ever well adjusted and in good order.

285. Naturalists, whose proper province it is to consider phenomena, experiments, mechanical organs and motions, principally regard the visible frame of things or corporeal word, supposing soul to be contained in body. And this hypothesis may be tolerated in physics, as it is not necessary in the art of dialling or

* Sect. 171.

† "For God the whole created mass inspires;
Through heaven, and earth, the ocean's depth he throws
His influence round, and kindles as he goes.
Hence flocks and herds, and men, and beasts and fowls
With breath are quickened, and attract their souls."—DRYDEN.

‡ Sect. 153, 172. § Sect. 145, 279.

navigation to mention the true system or earth's motion. But those who, not content with sensible appearances, would penetrate into the real and true causes (the object of theology, metaphysics, or the *philosophia prima*) will rectify this error, and speak of the world as contained by the soul, and not the soul by the world.

286. Aristotle hath observed there were indeed some who thought so grossly, as to suppose the universe to be one only corporeal and extended nature: but in the first book of his metaphysics he justly remarks they were guilty of a great mistake; forasmuch as they took into their account the elements of corporeal beings alone; whereas there are incorporeal beings also in the universe; and while they attempt to assign the causes of generation and corruption, and account for the nature of all things, they did at the same time destroy the very cause of motion.

287. It is a doctrine among other speculations contained in the Hermaic writings, that all things are one. And it is not improbable that Orpheus Parmenides, and others among the Greeks, might have derived their notion of τὸ ἕν, THE ONE, from Egypt. Though that subtile metaphysician Parmenides, in his doctrine of ἓν ἑστως, seems to have added something of his own. If we suppose, that one and the same mind is the universal principle of order and harmony throughout the world, containing and connecting all its parts, and giving unity to the system, there seems to be nothing atheistical or impious in this supposition,

288. Number is no object of sense: it is an act of the mind. The same thing in a different conception is one or many. Comprehending God and the creatures in one general notion, we may say that all things together make one universe, or τὸ πᾶν. But if we should say, that all things make one God; this would indeed be an erroneous notion of God, but would not amount to atheism, so long as mind or intellect was admitted to be the τὸ ἡγεμονικὸν, the governing part. It is nevertheless more respectful, and consequently the truer notion of God, to suppose him neither made up of parts, nor to be himself a part of any whole whatsoever.

289. All those, who conceived the universe to be an animal, must in consequence of that notion, suppose all things to be one. But to conceive God to be the sentient soul of an animal, is altogether unworthy and absurd. There is no sense, nor sensory, nor any thing like a sense or sensory in God. Sense implies an impression from some other being, and denotes a dependence in the soul which hath it. Sense is a passion: and passions imply imperfection. God knoweth all things, as pure mind or intellect, but nothing by sense, nor in nor through a sensory. Therefore to suppose a sensory of any kind, whether space or any other in

God, would be very wrong, and lead us into false conceptions of his nature. The presuming there was such a thing as real absolute uncreated space, seems to have occasioned that modern mistake. But this presumption was without grounds.

290. Body is opposite to spirit or mind. We have a notion of spirit from thought and action: we have a notion of body from resistance. So far forth as there is real power, there is spirit. So far forth as there is resistance, there is inability or want of power: that is, there is negation of spirit. We are embodied, that is, we are clogged by weight, and hindered by resistance. But in respect of a perfect spirit, there is nothing hard or impenetrable: there is no resistance to the deity: nor hath he any body: nor is the supreme being united to the world, as the soul of an animal is to its body, which necessarily implieth defect, both as an instrument and as a constant weight and impediment.

291. Thus much it consists with piety to say, that a divine agent doth by his virtue permeate and govern the elementary fire or light* which serves as animal spirit to enliven and actuate the whole mass, and all the members of this visible world. Nor is this doctrine less philosophical than pious. We see all nature alive or in motion. We see water turned into air, and air rarefied and made elastic† by the attraction of another medium, more pure indeed, more subtile and more volatile than air. But still, as this is a moveable, extended, and consequently, a corporeal being,‡ it cannot be itself the principle of motion, but leads us naturally and necessarily to an incorporeal spirit or agent. We are conscious that a spirit can begin, alter, or determinate motion, but nothing of this appears in body. Nay, the contrary is evident, both to experiment and reflection.

292. Natural phenomena are only natural appearances. They are, therefore, such as we see and perceive them. Their real and objective natures, are, therefore, the same; passive without any thing active, fluent and changing without any thing permanent in them. However, as these make the first impressions, and the mind takes her first flight and spring, as it were, by resting her foot on these objects, they are not only first considered by all men, but most considered by most men. They and the phantoms that result from those appearances, and the children of imagination grafted upon sense, such for example as pure space,§ are thought by many the very first in existence and stability, and to embrace and comprehend all other beings.

293. Now although such phantoms as corporeal forces, absolute motions, and real spaces, do pass in physics for causes and principles,‖ yet are they in truth but hypotheses, nor can they be the objects of real science. They pass nevertheless in physics

* Sect. 157, 172. † Sect. 149, 152, 200. ‡ Sect. 207
§ Sect. 270. ‖ Sect. 220, 249, 250.

conversant about things of sense, and confined to experiments and mechanics. But when we enter the province of the *philosophia prima*, we discover another order of beings, mind and its acts, permanent being, not dependent on corporeal things, nor resulting, nor connected, nor contained; but containing, connecting, enlivening the whole frame; and imparting those motions, forms, qualities, and that order and symmetry to all those transient phenomena, which we term the course of nature.

294. It is with our faculties as with our affections: what first seizes holds fast.* It is a vulgar theme that man is a compound of contrarieties, which breed a restless strûggle in his nature, between flesh and spirit, the beast and the angel, earth and heaven, ever weighed down and ever bearing up. During which conflict the character fluctuates: when either side prevails, it is then fixed for vice or virtue. And life from different principles takes a different issue. It is the same in regard to our faculties. Sense at first besets and overbears the mind. The sensible appearances are all in all: our reasonings are employed about them: our desires terminate in them: we look no farther for realities or causes; till intellect begins to dawn, and cast a ray on this shadowy scene. We then perceive the true principle of unity, identity, and existence. Those things that before seemed to constitute the whole of being, upon taking an intellectual view of things, prove to be but fleeting phantoms.

295. From the outward form of gross masses which occupy the vulgar, a curious inquirer proceeds to examine the inward structure and minute parts, and from observing the motions in nature, to discover the laws of those motions. By the way, he frames his hypothesis and suits his language to this natural philosophy. And these fit the occasion and answer the end of a maker of experiments or mechanic, who means only to apply the powers of nature, and reduce the phenomena to rules. But, if proceeding still in his analysis and inquiry, he ascends from the sensible into the intellectual world, and beholds things in a new light and a new order, he will then change his system, and perceive that what he took for substances and causes are but fleeting shadows: that the mind contains all, and is to all created beings the source of unity and identity, harmony and order, existence and stability.

296. It is neither acid, nor salt, nor sulphur, nor air, nor ether, nor visible corporeal fire,† much less the phantom fate, or necessity, that is the real agent, but by a certain analysis, a regular connexion and climax, we ascend through all those mediums to a glimpse of the first mover, invisible, incorporeal, unextended, intellectual source of life and being. There is, it must be owned, a mixture of obscurity and prejudice in human speech and reasonings. This is unavoidable, since the veils of

* Sect. 264. † Sect. 155.

prejudice and error are slowly and singly taken off one by one. But if there are many links in the chain which connects the two extremes of what is grossly sensible and purely intelligible, and it seem a tedious work, by the slow helps of memory, imagination, and reason, oppressed and overwhelmed, as we are, by the senses, through erroneous principles and long ambages of words and notions, to struggle upwards into the light of truth, yet as this gradually dawns, further discoveries still correct the style and clear up the notions.

297. The mind, her acts and faculties, furnish a new and distinct class of objects,* from the contemplation whereof arise certain other notions, principles, and verities, so remote from, and even so repugnant to, the first prejudices which surprise the sense of mankind, that they may well be excluded from vulgar speech and books, as abstract from sensible matters, and more fit for the speculation of truth, the labour and aim of a few, than for the practice of the world, or the subjects of experimental or mechanical inquiry. Nevertheless, though perhaps it may not be relished by some modern readers, yet the treating in physical books concerning metaphysical and divine matters can be justified by great authorities among the ancients: not to mention that he, who professedly delivers the elements of a science, is more obliged to method and system, and tied down to more rigorous laws, than a mere essay writer. It may, therefore, be pardoned if this rude essay doth, by insensible transitions, draw the reader into remote inquiries and speculations, that were not perhaps thought of, either by him or by the author, at first setting out.

298. There are traces of profound thought as well as primeval tradition in the Platonic, Pythagorean, Egyptian, and Chaldaic philosophy.† Men in those early days were not overlaid with languages and literature. Their minds seem to have been more exercised, and less burdened, than in later ages; and, as so much nearer the beginning of the world, to have had the advantage of patriarchal lights handed down through a few hands. It cannot indeed be affirmed (how probable soever it may seem) that Moses was that same Mochus, with whose successors, priests and prophets, Pythagoras is said to have conversed at Sidon. Yet the study of philosophy appears to be of very great antiquity and remote original; inasmuch as Timæus Locrensis, that ancient Pythagorean, author of the book concerning the soul of the world, speaks of a most ancient philosophy, even in his time, *ἀ πρεσβύστα φιλοσοφία*, stirring up and recovering the soul from a state of ignorance to the contemplation of divine things. And though the books attributed to Mercurius Trismegistus were none of them wrote by him, and are allowed to contain some manifest forgeries: yet it is also allowed that they contain tenets

* Sect. 163, 266. † Sect. 179, 266.

of the ancient Egyptian philosophy, though dressed perhaps in a more modern garb. To account for which, Jamblichus observes, that the books under his name contain indeed mercurial opinions, though often expressed in the style of the Greek philosophers; as having been translated from the Egyptian tongue into Greek.

299. The difference of Isis from Osiris* resembles that of the moon from the sun, of the female from the male, of *natura naturata* (as the schoolmen speak) from *natura naturans*. But Isis, though mostly taken for nature, yet (as the Pagan divinities were very fluctuating things) it sometimes signified τὸ πᾶν. And we find in Montfaucon an Isis of the ordinary form with this inscription, Θεοῦ πανός. And in the Mensa Isiaca, which seems to exhibit a general system of the religion and superstition of the Egyptians, Isis on her throne possesseth the centre of the table: which may seem to signify, that the universe, or τὸ πᾶν, was the centre of the ancient secret religion of the Egyptians; their Isis, or τὸ πᾶν, comprehending both Osiris, the author of nature, and his work.

300. Plato and Aristotle considered God as abstracted or distinct from the natural world; but the Egyptians considered God and nature as making one whole, or all things together as making one universe. In doing which, they did not exclude the intelligent mind, but considered it as containing all things. Therefore, whatever was wrong in their way of thinking, it doth not, nevertheless, imply or lead to atheism.

301. The human mind is so much clogged and borne downward by the strong and early impressions of sense,† that it is wonderful how the ancients should have made even such a progress, and seen so far into intellectual matters, without some glimmering of a divine tradition. Whoever considers a parcel of rude savages left to themselves, how they are sunk and swallowed up in sense and prejudice, and how unqualified by their natural force to emerge from this state, will be apt to think, that the first spark of philosophy was derived from heaven; and that it was, as a heathen writer expresseth it, θεοπαράδοτος φιλοσοφία.

302. The lapsed state of human kind is a thing to which the ancient philosophers were not strangers. The λύσις, the φύγη, the παλιγγενεσία, show that the Egyptians and Pythagoreans, the Platonists and Stoics, had all some notion of this doctrine, the outlines of which seem to have been sketched out in those tenets. Theology and philosophy gently unbind the ligaments that chain the soul down to the earth, and assist her flight towards the sovereign good. There is an instinct or tendency of the mind upwards, which showeth a natural endeavour to recover and raise ourselves, from our present sensual and low condition, into a state of light, order, and purity.

* Sect. 268. † Sect. 264.

303. The perceptions of sense are gross: but even in the senses there is a difference. Though harmony and proportion are not objects of sense, yet the eye and the ear are organs, which offer to the mind such materials, by means whereof she may apprehend both the one and the other. By experiments of sense we become acquainted with the lower faculties of the soul; and from them, whether by a gradual* evolution, or ascent, we arrive at the highest. Sense supplies images to memory. These become subjects for fancy to work upon. Reason considers and judges of the imaginations. And these acts of reason become new objects to the understanding. In this scale, each lower faculty is a step that leads to one above it. And the uppermost naturally lead to the deity, which is rather the object of intellectual knowledge than even of the discursive faculty, not to mention the sensitive. There runs a chain throughout the whole system of beings. In this chain one link drags another. The meanest things are connected with the highest. The calamity therefore is neither strange nor much to be complained of, if a low sensual reader shall, from mere love of the animal life, find himself drawn on, surprised, and betrayed into some curiosity concerning the intellectual.

304. There is, according to Plato, properly no knowledge, but only opinion, concerning things sensible and perishing,† not because they are naturally abstruse and involved in darkness: but because their nature and existence is uncertain, ever fleeting, and changing. Or rather, because they do not in strict truth exist at all, being always generating or *in fieri*, that is, in a perpetual flux, without any thing stable or permanent in them to constitute an object of real science. The Pythagoreans and Platonics distinguish between τὸ γενόμενον and τὸ ὄν, that which is ever generated, and that which exists. Sensible things and corporeal forms are perpetually producing and perishing, appearing and disappearing, never resting in one state, but always in motion and change; and therefore, in effect, not one being, but a succession of beings: while τὸ ὄν is understood to be somewhat of an abstract or spiritual nature, and the proper object of intellectual knowledge. Therefore, as there can be no knowledge of things flowing and instable, the opinion of Protagoras and Theætetus, that sense was science, is absurd. And indeed nothing is more evident, than that the apparent sizes and shapes, for instance, of things are in a constant flux, ever differing as they are viewed at different distances, or with glasses more or less accurate. As for those absolute magnitudes and figures, which certain Cartesians and other moderns suppose to be in things, that must seem a vain supposition to whoever considers, it is supported by no argument of reason, and no experiment of sense.

* Sect. 275. † Sect. 262, 264.

305. As understanding perceiveth not, that is, doth not hear, or see, or feel, so sense knoweth not: and although the mind may use both sense and fancy, as means whereby to arrive at knowledge, yet sense or soul, so far forth as sensitive, knoweth nothing. For, as it is rightly observed in the Theætetus of Plato, science consists not in the passive perceptions, but in the reasoning upon them, τῷ περὶ ἐκείνων συλλογισμῷ.

306. In the ancient philosophy of Plato and Pythagoras, we find distinguished three sorts of objects: in the first place, a form or species that is neither generated nor destroyed, unchangeable, invisible, and altogether imperceptible to sense, being only understood by the intellect. A second sort there is, ever fluent and changing,* generating and perishing, appearing and vanishing. This is comprehended by sense and opinion. The third kind is matter, which, as Plato teacheth, being neither an object of understanding nor of sense, is hardly to be made out by a certain spurious way of reasoning, λογισμῷ τινι νόθῳ μόγις πιστὸν. See his Timæus. The same doctrine is contained in the Pythagoric treatise, *De Anima Mundi*, which, distinguishing ideas, sensible things, and matter, maketh the first to be apprehended by intellect, the second by sense, and the last, to wit, matter, λογισμῷ νόθῳ. Whereof Themistius the Peripatetic assigns the reason. For, saith he, that act is to be esteemed spurious whose object hath nothing positive, being only a mere privation, as silence or darkness. And such he accounteth matter.

307. Aristotle maketh a threefold distinction of objects, according to the three speculative sciences. Physics he supposeth to be conversant about such things as have a principle of motion in themselves, mathematics about things permanent, but not abstracted, and theology about being abstracted and immoveable; which distinction may be seen in the ninth book of his metaphysics; where by abstracted, χωριστόν, he understands separable from corporeal beings and sensible qualities.

308. That philosopher held that the mind of man was a *tabula rasa*, and that there were no innate ideas. Plato, on the contrary, held original ideas in the mind, that is, notions which never were nor can be in the sense, such as being, beauty, goodness, likeness, parity. Some, perhaps, may think the truth to be this: that there are properly no ideas or passive objects in the mind, but what were derived from sense: but that there are also besides these her own acts or operations: such are notions.

309. It is a maxim of the Platonic philosophy, that the soul of man was originally furnished with native inbred notions, and stands in need of sensible occasions, not absolutely for producing them, but only for awakening, rousing, or exciting into act what was already pre-existent, dormant, and latent in the soul; as

* Sect. 292, 293.

things are said to be laid up in the memory, though not actually perceived, until they happen to be called forth and brought into view by other objects. This notion seemeth somewhat different from that of innate ideas, as understood by those moderns who have attempted to explode them. To understand and to be, are according to Parmenides the same thing. And Plato, in his seventh letter, makes no difference between νοῦς and ἐπιστήμη, mind and knowledge. Whence it follows, that mind, knowledge, and notions, either in habit or in act, always go together.

310. And albeit Aristotle considered the soul in its original state as a blank paper, yet he held it to be the proper place of forms: τὴν ψυχὴν εἶναι τόπον εἰδῶν.* Which doctrine, first maintained by others, he admits under this restriction, that it is not to be understood of the whole soul, but only of the νοητικὴ; as is to be seen in his third book *De Animâ*. Whence, according to Themistius, in his commentary on that treatise, it may be inferred, that all beings are in the soul. For, saith he, the forms are the beings. By the form every thing is what it is. And he adds, it is the soul that imparteth forms to matter; τὴν ὕγην μορφῶσα ποικίλαις μόρφαις. Therefore they are first in the soul. He further adds, that the mind is all things, taking the forms of all things, it becomes all things by intellect and sense. Alexander Aphrodisæus saith as much, affirming the mind to be all things, κατὰ τε τὸ νόειν καὶ τὸ αισθάνεσθαι. And this, in fact, is Aristotle's own doctrine in his third book *De Animâ;* where he also asserts, with Plato, that actual knowledge and the thing known are all one: τὸ ἀυτὸ δὲ ἐστὶν ἡ κατ' ἐνέργειαν ἐπιστήμη τῷ πράγματι. Whence it follows, that the things are where the knowledge is, that is to say, in the mind; or, as it is otherwise expressed, that the soul is all things. More might be said to explain Aristotle's notion, but it would lead too far.

311. As to an absolute actual existence† of sensible or corporeal things, it doth not seem to have been admitted either by Plato or Aristotle. In the Theætetus we are told, that if any one saith a thing is, or is made, he must withal say, for what, or of what, or in respect of what, it is, or is made; for, that any thing should exist in itself, or absolutely, is absurd. Agreeably to which doctrine, it is also further affirmed by Plato, that it is impossible a thing should be sweet, and sweet to nobody. It must nevertheless be owned with regard to Aristotle, that even in his metaphysics there are some expressions which seem to favour the absolute existence of corporeal things. For instance, in the eleventh book, speaking of corporeal sensible things, what wonder, saith he, if they never appear to us the same, no more than to sick men, since we are always changing, and never remain the same ourselves? And again, he saith, sensible things,

* Sect. 269. † Sect. 264, 292, 294.

although they receive no change in themselves, do nevertheless in sick persons produce different sensations, and not the same. These passages would seem to imply a distinct and absolute existence of the objects of sense.

312. But it must be observed, that Aristotle distinguisheth a twofold existence, potential and actual. It will not therefore follow that, according to Aristotle, because a thing is, it must actually exist. This is evident from the eighth book of his metaphysics, where he animadverts on the Megaric philosophers, as not admitting a possible existence distinct from the actual: from whence, saith he, it must follow, that there is nothing cold or hot or sweet or any sensible thing at all, where there is no perception. He adds, that in consequence of that Megaric doctrine, we can have no sense but while we actually exert it: we are blind when we do not see, and therefore both blind and deaf several times in a day.

313. The ἐντελέχειαι πρῶται of the Peripatetics, that is, the sciences, arts, and habits, were by them distinguished from the acts or ἐντελέχειαι δεύτεραι, and supposed to exist in the mind, though not exerted or put into act. This seems to illustrate the manner in which Socrates, Plato, and their followers conceive innate * notions to be in the soul of man. It was the Platonic doctrine, that human souls or minds descended from above, and were sowed in generation, that they were stunned, stupified, and intoxicated by this descent and immersion into animal nature. And that the soul, in this ὀνείρωξις, or slumber, forgets her original notions, which are smothered and oppressed by many false tenets and prejudices of sense. Insomuch that Proclus compares the soul, in her descent invested with growing prejudices, to Glaucus diving to the bottom of the sea, and there contracting divers coats of sea weed, coral, and shells, which stick close to him and conceal his true shape.

314. Hence, according to this philosophy, the mind of man is so restless to shake off that slumber, to disengage and emancipate herself from those prejudices and false opinions, that so straitly beset and cling to her, to rub off those covers that disguise her original form, and to regain her primeval state and first notions: hence that perpetual struggle to recover the lost region of light, that ardent thirst and endeavour after truth and intellectual ideas which she would neither seek to attain, nor rejoice in, nor know when attained, except she had some prenotion or anticipation of them, and they had lain innate and dormant like habits and sciences in the mind, or things laid up, which are called out and roused by recollection or reminiscence. So that learning seemeth in effect reminiscence.

314. The Peripatetics themselves distinguish between reminis-

* Sect. 309.

cence and mere memory. Themistius observes, that commonly the best memories go with the worst parts; but that reminiscence is most perfect in the most ingenious minds. And notwithstanding the *tabula rasa* * of Aristotle, yet some of his followers have undertaken to make him speak Plato's sense. Thus Plutarch the Peripatetic teacheth, as agreeable to his master's doctrine, that learning is reminiscence, and that the νοῦς καθ' ἕξιν is in children. Simplicius also, in his commentary on the third book of Aristotle Περὶ Ψυχῆς, speaketh of a certain interior reason in the soul, acting of itself, and originally full of its own proper notions, πλήρης ἀφ' ἑαυτοῦ τῶν οἰκείων γνωστῶν.

316. And, as the Platonic philosophy supposed intellectual notions to be originally inexistent or innate in in the soul † so likewise it supposed sensible qualities to exist (though not originally) in the soul, and there only. Socrates saith to Theætetus, you must not think the white colour that you see is in any thing without your eyes, or in your eyes, or in any place at all. And in the Timæus, Plato teacheth, that the figure and motion of the particles of fire dividing the parts of our bodies produce that painful sensation we call heat. And Plotinus, in the sixth book of his second Æneid, observes, that heat and other qualities are not qualities in the things themselves, but acts; that heat is not a quality but act in the fire: that fire is not really what we perceive in the qualities light, heat, and colour. From all which it is plain, that whatever real things they suppose to exist independent of the soul, those were neither sensible things, nor clothed with sensible qualities.

317. Neither Plato nor Aristotle by matter, ὕλη, understood corporeal substance, whatever the moderns may understand by that word. To them certainly it signified no positive actual being. Aristotle describes it as made up of negatives, having neither quantity nor quality nor essence. And not only the Platonists and Pythagoreans, but also the Peripatetics themselves declare it to be known, neither by sense, nor by any direct and just reasoning, but only by some spurious or adulterine method, as hath been observed before. Simon Portius, a famous Peripatetic of the sixteenth century, denies it to be any substance at all, for, saith he, *nequit per se subsistere quia sequeretur, id quod non est in actu esse in actu.* If Jamblichus may be credited, the Egyptians supposed matter so far from including aught of substance or essence, that according to them, God produced it by a separation from all substance, essence, or being, ἀπὸ οὐσιότητος ἀποχισθείσης ὑλότητος. That matter is actually nothing, but potentially all things, is the doctrine of Aristotle, Theophrastus, and all the ancient Peripatetics.

318. According to those philosophers, matter is only a *pura*

* Sect. 308. † Sect. 309, 314.

potentia, a mere possibility. But Anaximander, successor to Thales, is represented as having thought the supreme deity to be infinite matter. Nevertheless, though Plutarch calleth it matter yet it was simply τὸ ἄπειρον, which means no more than infinite or indefinite. And although the moderns teach that space is real and infinitely extended: yet if we consider that it is no intellectual notion, nor yet perceived by any of our senses, we shall perhaps be inclined to think with Plato in his Timæus, that this also is the result of λογισμὸς νόθος, or spurious reasoning, and a kind of waking dream. Plato observes, that we dream, as it were, when we think of place, and believe it necessary, that whatever exists should exist in some place. Which place or space * he also observes is μετ' ἀναισθησίας ἁπτὸν, that is, to be felt as darkness is seen, or silence heard, being a mere privation.

319. If any one should think to infer the reality or actual being of matter from the modern tenet, that gravity is always proportionable to the quantity of matter, let him but narrowly scan the modern demonstration of that tenet, and he will find it to be a vain circle, concluding in truth no more than this, that gravity is proportionable to weight, that is to itself. Since matter is conceived only as defect and mere possibility: and since God is absolute perfection and act; it follows, there is the greatest distance and opposition imagined between God and matter. Insomuch that a material God would be altogether inconsistent.

320. The force that produces, the intellect that orders, the goodness that perfects all things, is the supreme being. Evil, defects, negation, is not the object of God's creative power. From motion the Peripatetics trace out a first immoveable mover. The Platonics make God the author of all good, author of no evil, and unchangeable. According to Anaxagoras there was a confused mass of all things in one chaos, but mind supervening, ἐπελθὼν, distinguished and divided them. Anaxagoras, it seems ascribed the motive faculty to mind, which mind some subsequent philosophers have accurately discriminated from soul and life, ascribing to it the sole faculty of intellection.

321. But still God was supposed the first agent, the source and original of all things which he produceth, not occasionally or instrumentally, but with actual and real efficacy. Thus the treatise *De Secretiore Parte Divinæ Sapientiæ secundum Ægyptios*, in the tenth book, saith of God, that he is not only the first agent, but also that he it is who truly acts or creates, *qui verè efficit*.

322. Varro, Tully, and St. Augustin understand the soul to be *vis*, the power, or force that acts, moves, enlivens. Now although, in our conception, *vis*, or spirit, might be distinguished from mind, it would not thence follow, that it acts blindly or

* Sect. 250, 270.

without mind, or that it is not closely connected with intellect. If Plutarch is to be trusted in his account of the opinions of philosophers, Thales held the mind of the world to be God: Democritus held the soul of the world to be an igniform deity.* Pythagoras taught that God was the monad and the good, or τὸ ἀγαθον: Socrates also and Plato pronounced him to be the τὸ ἕν,† the single, self-originate one, essentially good. Each of which appellations and forms of speech directly tends to, and determines in mind, εἰς τὸν νοῦν σπένδει, saith Plutarch.

323. Whence that author concludes, that in the sense of those philosophers God is a mind; χωριστὸν εἶδος, not an abstract idea compounded of inconsistencies and prescinded from all real things, as some moderns understand abstraction; but a really existing spirit, distinct or separate from all sensible and corporeal beings. And although the Stoics are represented as holding a corporeal deity, or that the very system of the world is God, yet it is certain they did not, at bottom, dissent from the forementioned doctrine; inasmuch as they supposed the world to be an animal,‡ consisting of soul or mind as well as body.

324. This notion was derived from the Pythagoreans, who held the world, as Timæus Locrus teacheth, to be one perfect animal, endued with soul and reason: but then they believed it to have been generated: whereas the Stoics looked on the world as the supreme God, including therein mind or intellect. For the elementary fire, or, if one may so speak, the animal spirit of the world, seemeth according to them, to have been the vehicle of the soul,§ intellect or νοῦς; since they styled the divinity πῦρ νοερὸν,‖ or intellectual fire.

325. The Egyptians, if we may credit the Hermaic writings, maintained God to be all things, not only actual but possible. He is styled by them, that which is made and that which is unmade. And therein it is said, Shall I praise thee for those things thou hast made manifest, or for the things thou hast hidden? Therefore, in their sense, to manifest, was to create; the things created having been before hidden in God.

326. Now, whether the νοῦς be abstracted from the sensible world, and considered by itself, as distinct from, and presiding over the created system, or whether the whole universe, including mind together with the mundane body, is conceived to be God,¶ and the creatures to be partial manifestations of the divine essence, there is no atheism in either case, whatever misconceptions there may be; so long as mind or intellect is understood to preside over, govern, and conduct the whole frame of things. And this was the general prevailing opinion among the philosophers.

* Sect. 166, 168, 277. † Sect. 287.
‡ Sect. 276, 279. § Sect. 277, 284. ‖ Sect. 272. ¶ Sect. 300.

327. Nor if any one, with Aristotle in his metaphysics, should deny that God knows any thing without himself, seeing that God comprehends all things, could this be justly pronounced an atheistical opinion. Nor even was the following notion of the same author to be accounted atheism, to wit, that there are some things beneath the knowledge of God, as too mean, base, and vile; however wrong this notion may be, and unworthy of the divine perfection.

328. Might we not conceive that God may be said to be all in divers senses; as he is the cause and origin of all beings; as the νοῦς is the νοητὰ, a doctrine both of Platonics and Peripatetics* as the νοῦς is the place of all forms, and as it is the same which comprehends and orders† and sustains the whole mundane system. Aristotle declares, that the divine force or influence permeates the entire universe,‡ and that what the pilot is in a ship, the driver in a chariot, the precentor in a choir, the law in a city, the general in an army, the same God is in the world. This he amply sets forth in his book *De Mundo*, a treatise which having been anciently ascribed to him, ought not to be set aside from the difference of style, which (as Patricius rightly observes) being in a letter to a king, might be well supposed to differ from the other dry and crabbed parts of his writings.

329. And although there are some expressions to be met with in the philosophers, even of the Platonic and Aristotelic sects, which speak of God as mixing with, or pervading all nature and all the elements; yet this must be explained by force and not by extension, which was never attributed to the mind§ either by Aristotle or Plato. This they always affirmed to be incorporeal: and, as Plotinus remarks, incorporeal things are distant each from other not by place, but (to use his expression) by alterity.

330. These disquisitions will probably seem dry and useless to such readers as are accustomed to consider only sensible objects. The employment of the mind on things purely intellectual is to most men irksome: whereas the sensitive powers by constant use acquire strength. Hence, the objects of sense more forcibly affect us,‖ and are too often counted the chief good. For these things men fight, cheat, and scramble. Therefore, in order to tame mankind and introduce a sense of virtue, the best human means is to exercise their understanding, to give them a glimpse of another world, superior to the sensible, and while they take pains to cherish and maintain the animal life, to teach them not to neglect the intellectual.

331. Prevailing studies are of no small consequence to a state, the religion, manners, and civil government of a country ever taking some bias from its philosophy, which affects not only the

* Sect. 309, 310. † Sect. 320. ‡ Sect. 173.
§ Sect. 290, 293, 297, 319. ‖ Sect. 264, 294.

minds of its professors and students, but also the opinions of all the better sort, and the practice of the whole people, remotely and consequently indeed, though not inconsiderably. Have not the polemic and scholastic philosophy been observed to produce controversies in law and religion? And have not Fatalism and Sadducism gained ground, during the general passion for the Corpuscularian and mechanical philosophy, which hath prevailed for about a century? This indeed might usefully enough have employed some share of the leisure and curiosity of inquisitive persons. But when it entered the seminaries of learning as a necessary accomplishment, and most important part of education, by engrossing men's thoughts, and fixing their minds so much on corporeal objects, and the laws of motion, it hath, however undesignedly, indirectly, and by accident, yet not a little indisposed them for spiritual, moral, and intellectual matters. Certainly had the philosophy of Socrates and Pythagoras prevailed in this age, among those who think themselves too wise to receive the dictates of the gospel, we should not have seen interest take so general and fast hold on the minds of men, nor public spirit reputed to be γενναῖαν εὐήθειαν, a generous folly among those who are reckoned to be the most knowing as well as the most getting part of mankind.

332. It might very well be thought serious trifling to tell my readers that the greatest men had ever an high esteem for Plato; whose writings are the touchstone of a hasty and shallow mind; whose philosophy has been the admiration of ages; which supplied patriots, magistrates, and lawgivers to the most flourishing states, as well as fathers to the church, and doctors to the schools. Albeit in these days, the depths of that old learning are rarely fathomed, and yet it were happy for these lands, if our young nobility and gentry instead of modern maxims would imbibe the notions of the great men of antiquity. But in these freethinking times many an empty head is shook at Aristotle and Plato, as well as at the holy scriptures. And the writings of those celebrated ancients are by most men treated on a foot, with the dry and barbarous lucubrations of the schoolmen. It may be modestly presumed, there are not many among us, even of those who are called the better sort, who have more sense, virtue, and love of their country than Cicero, who in a letter to Atticus could not forbear exclaiming, *O Socrates et Socratici viri! nunquam vobis gratiam referam.* Would to God many of our countrymen had the same obligations to those Socratic writers. Certainly where the people are well educated, the art of piloting a state is best learned from the writings of Plato. But among bad men, void of discipline and education, Plato, Pythagoras, and Aristotle themselves, were they living, could do but little good. Plato hath drawn a very humorous and instructive picture of such a

state; which I shall not transcribe for certain reasons. But whoever has a mind, may see it in the seventy-eighth page of the second tome of Aldus's edition of Plato's works.

333. Proclus, in the first book of his commentary on the theology of Plato, observes, that, as in the mysteries, those who are initiated, at first meet with manifold and multiform gods, but being entered and thoroughly initiated they receive the divine illumination, and participate the very deity: in like manner, if the soul looks abroad she beholds the shadows and images of things: but returning into herself she unravels and beholds her own essence: at first she seemeth only to behold herself: but having penetrated further, she discovers the mind. And again, still further advancing into the innermost sanctuary of the soul, she contemplates the θεῶν γένος. And this, he saith, is the most excellent of all human acts, in the silence and repose of the faculties of the soul to tend upwards to the very divinity; to approach and be closely joined with that which is ineffable and superior to all beings. When come so high as the first principle she ends her journey and rests. Such is the doctrine of Proclus.

334. But Socrates, in the first Alcibiades teacheth, on the other hand, that the contemplation of God is the proper means to know or understand our own soul. As the eye, saith he, looking stedfastly at the visive part or pupil of another eye beholds itself, even so the soul beholds and understands herself, while she contemplates the deity which is wisdom and virtue, or like thereunto. In the Phædon, Socrates speaks of God as being τὸ ἀγαθὸν and τὸ δέον,* Plotinus represents God as order: Aristotle as law.

335. It may seem perhaps to those who have been taught to discourse about substratums, more reasonable and pious to attribute to the deity a more substantial being, than the notional entities of wisdom, order, law, virtue, or goodness, which being only complex ideas, framed and put together by the understanding, are its own creatures, and have nothing substantial, real, or independent in them. But it must be considered, that in the Platonic system, order, virtue, law, goodness, and wisdom, are not creatures of the soul of man, but innate and originally existent therein, not as an accident in a substance, but as light to enlighten, and as a guide to govern. In Plato's style, the term idea doth not merely signify an inert inactive object of the understanding, but is used as synonymous with αἴτιον and ἀρχὴ, cause and principle. According to that philosopher, goodness, beauty, virtue, and such like, are not figments of the mind, nor mere mixed modes, nor yet abstract ideas in the modern sense, but the most real beings, intellectual and unchangeable: and therefore more real than the fleeting transient objects of sense,†

* Sect. 260, 320. † Sect. 306.

which wanting stability cannot be subjects of science,* much less of intellectual knowledge.

336. By Parmenides, Timæus, and Plato, a distinction was made, as hath been observed already, between *genitum* and *ens*. The former sort is always a generating, or *in fieri*,† but never exists, because it never continues the same, being in a constant change, ever perishing and producing. By *entia* they understand things remote from sense, invisible and intellectual, which never changing are still the same, and may therefore be said truly to exist, *οὐσία*, which is generally translated substance, but more properly essence, was not thought to belong to things sensible and corporeal, which have no stability; but rather to intellectual ideas, though discerned with more difficulty, and making less impression on a mind stupified and immersed in animal life, than gross objects that continually beset and solicit our senses.

337. The most refined human intellect, exerted to its utmost reach, can only seize some imperfect glimpses‡ of the divine ideas, abstracted from all things corporeal, sensible, and imaginable. Therefore Pythagoras and Plato treated them in a mysterious manner, concealing rather than exposing them to vulgar eyes; so far were they from thinking, that those abstract things, although the most real, were the fittest to influence common minds, or become principles of knowledge, not to say duty and virtue to the generality of mankind.

338. Aristotle and his followers have made a monstrous representation of the Platonic ideas; and some of Plato's own school have said very odd things concerning them. But if that philosopher himself was not read only, but studied also with care, and made his own interpreter, I believe the prejudice that now lies against him would soon wear off,§ or be even converted into high esteem for those exalted notions and fine hints, that sparkle and shine throughout his writings; which seem to contain not only the most valuable learning of Athens and Greece, but also a treasure of the most remote traditions and early science of the East.

339. In the Timæus of Plato mention is made of ancient persons, authors of traditions, and the offspring of the gods. It is very remarkable, that in the account of the creation contained in the same piece, it is said that God was pleased with his work, and that the night is placed before the day. The more we think, the more difficult shall we find it to conceive, how mere man, grown up in the vulgar habits of life, and weighed down by sensuality, should ever be able to arrive at science, without some tradition‖ or teaching, which might either sow the seeds of knowledge, or call forth and excite those latent seeds that were originally sown in the soul.

* Sect. 264, 266, 297. † Sect. 304, 306. ‡ Sect. 313, 330.
§ Sect. 309, 313. ‖ Sect. 298, 301, 302.

340. Human souls in this low situation, bordering on mere animal life, bear the weight and see through the dusk of a gross atmosphere, gathered from wrong judgments daily passed, false opinions daily learned, and early habits of an older date than either judgment or opinion. Through such a medium the sharpest eye cannot see clearly.* And if by some extraordinary effort the mind should surmount this dusky region, and snatch a glimpse of pure light, she is soon drawn backward and depressed by the heaviness of the animal nature to which she is chained. And if again she chanceth, amidst the agitation of wild fancies and strong affections, to spring upwards, a second relapse speedily succeeds into this region of darkness and dreams.

341. Nevertheless, as the mind gathers strength by repeated acts, we should not despond, but continue to exert the prime and flower of our faculties, still recovering, and reaching on, and struggling into the upper region, whereby our natural weakness and blindness may be in some degree remedied, and a taste attained of truth and intellectual life. Beside the constant prevailing opinion of the greatest men of antiquity, that there is both a universal spirit, author of life and motion, and a universal mind, enlightening and ordering all things. It was a received tenet among them, that there is also τὸ ἕν, or τὸ ἀγαθὸν,† which they looked on as the *fons deitatis*, the first hypostatis in the divinity.

342. The one, or τὸ ἕν, being immutable and indivisible, always the same and entire, was therefore thought to exist truly and originally, and other things only so far as they are one and the same, by participation of τὸ ἕν. This gives unity, stability, reality to things.‡ Plato describes God, as Moses, from his being. According to both, God is he who truly is, ὁ ὄντως ὤν. Change and division were esteemed defects, or bad. Evil scatters, divides, destroys. Good, on the contrary, produceth concord and union, assembles, combines, perfects, and preserves entire. The several beings which compose the universe are parts of the same system, they combine to carry on one end, and perfect one whole. And this aptness and concurrence thereunto furnishes the partial particular idea of good in the distinct creatures. Hence it might have come to pass, that τὸ ἀγαθὸν and τὸ ἕν were regarded as one and the same.

343. Light and sight (saith Plato in the sixth book of his Republic) are not the sun: even so truth and knowledge are not the good itself, although they approach thereunto. And again, what the sun is in a visible place with respect to sight and things seen, that same is τὸ ἀγαθὸν, or good, in an intelligible place, with respect to understanding and things understood. Therefore

* Sect. 292—294. † Sect. 322.
‡ Sect. 264, 306.

the good, or one, is not the light that enlightens, but the source of that light.

344. Every moment produceth some change in the parts of this visible creation. Something is added or diminished, or altered in essence, quantity, quality, or habitude. Wherefore all generated beings were said by the ancients to be in a perpetual flux.* And that which, on a confused and general view, seems one single, constant being, shall upon a nearer inspection appear a continued series of different beings. But God remains for ever one and the same: therefore God alone exists. This was the doctrine of Heraclitus, Plato, and other ancients.

345. It is the opinion of Plato and his followers, that in the soul of man, prior and superior to intellect, there is somewhat of a higher nature, by virtue of which we are one; and that by means of our one or unit, we are most closely joined to the deity. And as by our intellect we touch the divine intellect, even so by our τὸ ἕν, or unit, the very flower of our essence, as Proclus expresseth it, we touch the first one.

346. According to the Platonic philosophy, *ens* and *unum* are the same. And, consequently, our minds participate so far of existence as they do of unity. But it should seem that personality is the indivisible centre of the soul or mind, which is a monad so far forth as she is a person. Therefore, person is really that which exists, inasmuch as it participates the divine unity. In man the monad or indivisible is the αὐτὸ τὸ αὐτὸ, the selfsame self, or very self, a thing, in the opinion of Socrates, much and narrowly to be inquired into and discussed, to the end that, knowing ourselves, we may know what belongs to us and our happiness.

347. Upon mature reflection, the person or mind of all created beings seemeth alone indivisible, and to partake most of unity. But sensible things are rather considered as one than truly so, they being in a perpetual flux or succession, ever differing and various. Nevertheless, all things together may be considered as one universe,† one by the connexion, relation, and order of its parts, which is the work of mind, whose unit is by Platonics supposed a participation of the first τὸ ἕν.

348. Socrates, in the Theætetus of Plato, speaketh of two parties of philosophers, the ῥέοντες and οἱ τοῦ ὅλου στασιῶται, the flowing philosophers, who held all things to be in a perpetual flux, always a generating and never existing; and those others who maintained the universe to be fixed and immoveable. The difference seems to have been this, that Heraclitus, Protagoras, Empedocles, and in general those of the former sect, considered things sensible and natural; whereas Parmenides and his party

* Sect. 304, 336. † Sect. 287, 288.

considered τὸ πᾶν, not as the sensible but as the intelligible world,* abstracted from all sensible things.

349. In effect, if we mean by things the sensible objects, these it is evident are always flowing; but if we mean things purely intelligible, then we may say on the other hand, with equal truth, that they are immoveable and unchangeable. So that those who thought the whole, or τὸ πᾶν, to be ἓν ἑστως, a fixed or permanent one, seem to have understood the whole of real beings, which in their sense was only the intellectual world, not allowing reality of being to things not permanent.

350. The displeasure of some readers may perhaps be incurred, by surprising them into certain reflections and inquiries for which they have no curiosity. But perhaps some others may be pleased to find a dry subject varied by digressions, traced through remote inferences, and carried into ancient times, whose hoary maxims† scattered in this essay are not proposed as principles, but barely as hints to awaken and exercise the inquisitive reader, on points not beneath the attention of the ablest men. Those great men, Pythagoras, Plato, and Aristotle, the most consummate in politics, who founded states, or instructed princes, or wrote most accurately on public government, were at the same time most acute at all abstracted and sublime speculations; the clearest light being ever necessary to guide the most important actions. And whatever the world thinks, he who hath not much meditated upon God, the human mind, and the *summum bonum*, may possibly make a thriving earth-worm, but will most indubitably make a sorry patriot and a sorry statesman.

351. According to the nice metaphysics of those ancient philosophers, το ἓν, being considered as what was first and simplest in the deity, was prescinded even from entity, to which it was thought prior and superior, and is therefore by the Platonics styled superessential. And in the Parmenides it is said, τὸ ἓν doth not exist; which might seem to imply a negation of the divine being. The truth is, Zeno and Parmenides argued, that a thing existing in time was older and younger than itself; therefore the constant immutable τὸ ἓν did not exist in time; and, if not in time, then in none of the differences of time past, present, or to come; therefore we cannot say that it was, is, or will be. But, nevertheless, it is admitted in the same Parmenides, that τὸ νῦν is every where present to τὸ ἓν; that is, instead of a temporary succession of moments, there is one eternal now, or *punctum stans*, as it is termed by the schoolmen.

352. The simplicity of τὸ ἓν (the father in the Pythagoric and Platonic trinity) is conceived such as to exclude intellect or mind, to which it is supposed prior. And that hath created a suspicion of atheism in this opinion. For saith the learned Dr. Cud-

* Sect. 293—295. † Sect. 298, 301.

worth, shall we say that the first hypostasis or person is ἄνους and ἄλογος, senseless and irrational, and altogether devoid of mind and understanding? or would not this be to introduce a kind of mysterious atheism? To which it may be answered, that whoever acknowledgeth the universe to be made and governed by an eternal mind, cannot be justly deemed an atheist.* And this was the tenet of those ancient philosophers. In the Platonic doctrine, the generation of the νοῦς or λόγος was not contingent but necessary, not temporary, but from everlasting. There never was a time supposed wherein τα ἕν subsisted without intellect, the priority having been understood only as a priority of order or conception, but not a priority of age. Therefore, the maintaining a distinction of priority between τὸ ἕν and νοῦς doth not infer, that the one ever existed without the other. It follows, therefore, that the father or τὸ ἕν may, in a certain sense, be said to be ἄνους without atheism, or without destroying the notion of a deity; any more than it would destroy the notion of a human soul, if we should conceive a distinction between self and intellect, or intellect and life. To which we may further add, that it is a doctrine of Platonics, and agrees with their master's tenets, to say that τὸ ἕν, or the first hypothesis, contains all excellence and perfection whereof it is the original source, and is more eminent, as the schools speak, intellect and life, as well as goodness; while the second hypostatis is essentially intellect, and by participation goodness and life; and the third, life essentially, and by participation goodness and intellect.

353. Therefore, the whole being considered, it will not seem just to fix the imputation of atheism upon those philosophers, who held the doctrine of τὸ ἕν; whether it be taken in an abstracted or collective, a metaphysical or merely vulgar, meaning;† that is, whether we prescind unity from essence and intellect, since metaphysical distinctions of the divine attributes do not in reality divide them; or whether we consider the universal system of beings as one, since the union, connexion, and order of its members, do manifestly infer a mind or intelleet to be cause thereof.

354. The one or τὸ ἕν may be conceived either by composition or division. For as, on the one hand, we may say the world or universe is ONE whole or ONE animal; so we may, on the other hand, consider τὸ ἕν by division or abstraction, as somewhat in the order of things prior to mind. In either sense there is no atheism, so long as mind is admitted to preside and direct the animal; and so long as the *unum* or τὸ ἕν is supposed not to exist without mind.‡ So that neither Heraclitus nor Parmenides, nor Pythagoras nor Plato, neither the Egyptians nor Stoics, with their doctrine of a divine whole or animal, nor Xenophanes with

* Sect. 154, 276, 279, 287. † Sect. 300. ‡ Sect. 287, 288.

his ἓν καὶ πᾶν, are justly to be accounted atheists. Therefore modern atheism, be it of Hobbes, Spinosa, Collins, or whom you will, is not to be countenanced by the learning and great names of antiquity.

355. Plato teacheth, that the doctrine concerning the one or unit is a means, to lead and raise the mind* to the knowledge of him who truly is. And it is a tenet both of Aristotle and Plato, that identity is a certain unity. The Pythagoreans also, as well as the Platonic philosophers, held *unum* and *ens* to be the same. Consistently with which, that only can be said to exist, which is one and the same. In things sensible and imaginable, as such, there seems to be no unity, nothing, that may be called one prior to all act of the mind; since they being in themselves aggregates, consisting of parts or compounded of elements, are in effect many. Accordingly it is remarked by Themistius, the learned interpreter of Aristotle, that to collect many notions into one, and to consider them as one, is the work of intellect and not of sense or fancy.

356. Aristotle himself, in his third book of the soul, saith it is the mind that maketh each thing to be one, τὸ δὲ ἓν ποιοῦν τοῦτο ὁ νοῦς ἕκαστον. How this is done, Themistius is more particular, observing, that as being conferreth essence, the mind by virtue of her simplicity conferreth simplicity upon compounded beings. And, indeed, it seemeth that the mind, so far forth as person, is individual,† therein resembling the divine one by participation, and imparting to other things what itself participates from above. This is agreeable to the doctrine of the ancients, however the contrary opinion of supposing number to be an original primary quality in things, independent of the mind, may obtain among the moderns.

357. The Peripatetics taught, that in all divisible things there was somewhat indivisible, and in all compounded things somewhat simple. This they derived from an act of the mind. And neither this simple indivisible unit, nor any sum of repeated units, consequently no number can be separated from the things themselves, and from the operation of the mind. Themistius goeth so far as to affirm, that it cannot be separated from the words or signs; and, as it cannot be uttered without them, so saith he, neither can it be conceived without them. Thus much upon the whole may be concluded, that distinct from the mind and her operations, there is in created beings neither unit nor number.

358. Of inferior beings the human mind, self, or person, is the most simple and undivided essence.‡ And the supreme father is the most perfect one. Therefore the flight of the mind towards God is called by the Platonics φυγὴ μόνου πρὸς μόνον. The supreme being, saith Plotinus, as he excludes all diversity is ever

* Sect. 294, 295. † Sect. 345, 346, 347. ‡ Sect. 347.

alike present. And we are then present to him, when, recollected and abstracted from the world and sensible objects, we are most free and disengaged* from all variety. He adds, that in the intuition of the supreme deity the soul finds her wished for end and repose; which that philosopher calls awaking out of his body into himself.

359. In the tenth book of the Arcane, or Divine Wisdom of the Egyptians, we are taught that the supreme being is not the cause of any created thing; but that he produced or made the word; and that all created beings were made by the word, which is accordingly styled the cause of all causes: and that this was also the doctrine of the Chaldeans. Plato, likewise, in his letter to Hermias, Erastus, and Coriscus, speaks of God the ruler and cause of all things as having a father: and, in his Epinomis, he expressly teacheth that the word or λόγος made the world. Accordingly St. Augustine in his commentary on the beginning of St. John's Gospel, having declared that Christ is the wisdom of God by which all things were made, observes that this doctrine was also found in the writings of philosophers, who taught that God had an only begotten Son by whom are all things.

360. Now, though Plato had joined with an imagination the most splendid and magnificent an intellect not less deep and clear; yet it is not to be supposed, that either he or any other philosophers of Greece or the East, had by the light of nature attained an adequate notion of the Holy Trinity, nor even that their imperfect notion, so far as it went, was exactly just; nor perhaps that those sublime hints, which dart forth like flashes of light in the midst of a profound darkness, were originally struck from the hard rock of human reason; but rather derived, at least in part, by a divine tradition† from the author of all things. It seems a remarkable confirmation of this, what Plotinus observed in his fifth Æneid, that this doctrine of a trinity, father, mind, and soul, was no late invention, but an ancient tenet.

361. Certain it is, that the notion of a trinity is to be found in the writings of many old heathen philosophers, that is to say, a notion of three divine hypostases. Authority, light, and life, did, to the eye of reason, plainly appear to support, pervade, and animate, the mundane system or macrocosm. The same appeared in the microcosm, preserving soul and body, enlightening the mind, and moving the affections. And these were conceived to be necessary, universal principles, coexisting and cooperating in such sort, as never to exist asunder, but, on the contrary, to constitute one sovereign of all things. And, indeed, how could power or authority avail or subsist without knowledge? or either without life and action?

* Sect. 268. † Sect. 298, 301.

362. In the administration of all things there is authority to establish, law to direct, and justice to execute. There is first the source of all perfection, or *fons deitatis;* secondly, the supreme reason, order, or λόγος; and, lastly, the spirit which quickens and inspires. We are sprung from the Father, irradiated or enlightened by the Son, and moved by the Spirit. Certainly, that there is Father, Son, and Spirit; that these bear analogy to the sun, light, and heat; and are otherwise expressed by the terms principle, mind, and soul; by one or τὸ ἕν, intellect, and life; by good, word, and love; and that generation was not attributed to the second hypostasis, the νοῦς or λόγος, in respect of time,* but only in respect of origin and order, as an eternal necessary emanation; these are the express tenets of Platonists, Pythagoreans, Egyptians, and Chaldeans.

363. Though it may be well presumed, there is nothing to be found on that sublime subject in human writings, which doth not bear the sure signatures of humanity; yet it cannot be denied, that several fathers of the church have thought fit to illustrate the Christian doctrine of the Holy Trinity, by similitudes and expressions borrowed from the most eminent heathens, whom they conceived to have been no strangers to that mystery, as hath been plainly proved by Bessarian, Eugubinus, and Dr. Cudworth.

364. Therefore, how unphilosophical soever that doctrine may seem to many of the present age, yet it is certain, the men of greatest fame and learning among the ancient philosophers, held a Trinity in the Godhead. It must be owned, that upon this point some later Platonists of the Gentile world seem to have bewildered themselves, (as many Christians have also done,) while they pursued the hints derived from their predecessors with too much curiosity.

365. But Plato himself considered that doctrine as a venerable mystery, not to be lightly treated of, or rashly divulged. Wherefore, in a letter to Dionysius he writes, (as he himself professeth) enigmatically and briefly, in the following terms, which he giveth for a summary of his notion concerning the supreme being, and which being capable of divers senses, I leave to be deciphered by the learned reader. Περὶ τὸν πάντων βασιλέα παντ' ἐστὶ, καὶ ἐκείνου ἕνεκα πάντα, καὶ ἐκεῖνο αἴτιον ἁπάντων τῶν καλῶν, δεύτερον δὲ περὶ τὰ δεύτερα, καὶ τρίτον περὶ τὰ τρίτα. Plato enjoins Dionysius over and over, with great earnestness, not to suffer what he communicates concerning the mysteries of the divine nature, to fall into illiterate or vulgar hands, giving it withal as a reason for this caution, that nothing would seem more ridiculous or absurd to the common run of mankind. He adds, that in regard writings might miscarry, the

* Sect. 352.

prudent way was to write nothing at all on those matters, but to teach and learn them by word of mouth: for which reason, saith he, I have never wrote any thing thereon; nor is there, nor shall there ever be, any thing of Plato's extant on that subject. He further adds, as for what hath been now said, it belongs all to Socrates.

366. And, indeed, what this philosopher in his Phædrus speaketh of the supercelestial region, and the divinity resident therein, is of a strain not to be relished or comprehended by vulgar minds, to wit, essence really existent, object of intellect alone, without colour, without figure, without any tangible quality. He might very justly conceive, that such a description must seem ridiculous to sensual men.

367. As for the perfect intuition of divine things, that he supposeth to be the lot of pure souls, beholding by a pure *light*, initiated, happy, free, and unstained from those bodies, wherein we are now imprisoned like oysters. But in this mortal state, we must be satisfied to make the best of those glimpses * within our reach. It is Plato's remark in his Theætetus, that while we sit still we are never the wiser, but going into the river and moving up and down, is the way to discover its depths and shallows. If we exercise and bestir ourselves, we may even here discover something.

368. The eye, by long use, comes to see even in the darkest cavern: and there is no subject so obscure, but we may discern some glimpse of truth by long poring on it. Truth is the cry of all, but the game of a few. Certainly, where it is the chief passion, it doth not give way to vulgar cares and views; nor is it contented with a little ardour in the early time of life, active perhaps to pursue, but not so fit to weigh and revise. He that would make a real progress in knowledge, must dedicate his age as well as youth, the later growth as well as first fruits, at the altar of truth.

Cujusvis est errare, nullius nisi insipientis in errore perseverare.—Cic.

* Sect. 335, 337.

A LETTER TO T. P. ESQ.;

CONTAINING SOME

FARTHER REMARKS ON THE VIRTUES OF TAR WATER,

AND THE METHODS FOR PREPARING AND USING IT

1. AMONG the great numbers who drink tar water in Dublin, your letter informs me, there are some that make or use it in an undue manner. To obviate those inconveniencies, and render this water as generally useful as possible, you desire I would draw up some rules and remarks in a small compass, which accordingly I here send you.

2. Pour a gallon of cold water on a quart of liquid tar, stir, mix, and work them thoroughly together, with a wooden ladle, or flat stick, for the space of five or six minutes. Then let the vessel stand close covered three days and nights, that the tar may have full time to subside. After which, having first carefully skimmed it, without moving the vessel, pour off the clear water, and keep it in bottles well corked for use. This method will produce a liquor stronger than that first published in Siris, but not offensive, if carefully skimmed. It is a good general rule, but as stomachs and constitutions are various, it may admit of some latitude. Less water or more stirring makes it stronger, as more water or less stirring makes it weaker. It is to be noted, that if several gallons are made at once in the same vessel, you must add five or six minutes stirring for every gallon. Thus two gallons of water, and two quarts of tar, require ten or twelve minutes stirring.

3. The same tar will not do so well a second time, but may serve for other common uses: the putting off tar that hath been used for fresh tar, would be a bad fraud. To prevent which it is to be noted, that tar already used is of a lighter brown than other tar. The only tar that I have used is that from our northern colonies in America, and that from Norway, the latter being thinner, mixeth easier with water, and seems to have more spirit. If the former be made use of (as I have known it with good success) the tar water will require longer stirring to make it.

4. Tar water when right, is not paler than French nor deeper coloured than Spanish white wine, and full as clear; if there be

not a spirit very sensibly perceived in drinking, you may conclude the tar water is not good; if you would have it good, see it made yourself. Those who begin with it, little and weak, may by habit come to drink more and stronger. According to the season, or the humour of the patient, it may be drank either cold or warm; in colics, I take it to be best warm. If it disgusts a patient warm, let him try it cold, and *vice versâ*. If at first it create to some squeamish persons a little sickness at stomach, or nauseating, it may be reduced both in quality and quantity. In general, small inconveniencies are either removed, or borne with small trouble; it lays under no restraint as to air, exercise, clothes, or diet, and may be taken at all times in the year.

5. As to the quantity in common chronical indispositions, one pint of tar water a day may suffice, taken on an empty stomach, at two or four times, to wit, night and morning, and about two hours after dinner and breakfast; more may be taken by strong stomachs. Alteratives in general, taken in small doses, and often, mix best with the blood, how oft or how strong each stomach can bear experience will show. But those who labour under great and inveterate maladies, must drink a greater quantity, at least one quart every twenty-four hours, taken at four, six, or eight glasses, as best suits the circumstances and case of the drinker. All of this class must have much patience and perseverance in the use of this, as well as of all other medicines, which, if sure and safe, must yet, from the nature of things, be slow in the cure of all inveterate chronical disorders. In acute cases, fevers of all kinds, it must be drank in bed warm, and in great quantity, the fever still enabling the patient to drink, perhaps a pint every hour, which I have known to work surprising cures. But it works so quick, and gives such spirits, that the patients often think themselves cured before the fever hath quite left them. Such therefore should not be impatient to rise, or apply themselves too soon to business or their usual diet.

6. To some, perhaps, it may seem, that a slow alterative in chronical cases cannot be depended on in fevers and acute distempers, which demand immediate relief. But I affirm that this same medicine, which is a slow alterative in chronical cases, I have found to be also a most immediate remedy, when copiously taken, in acute and inflammatory cases. It might indeed be thought rash to have tried it in the most threatening fevers and pleurisies without bleeding, which in the common practice would have been held necessary. But for this I can say, that I had patients who would not be bled, and this obliged me to make trials of tar water without bleeding, which trials I never knew unsuccessful. The same tar water I found a slow alterative, and a sudden febrifuge. If the reader is surprised, I own myself to be so too. But truth is truth, and from whatever hand it comes

should be candidly received. If physicians think they have a right to treat of religious matters, I think I have an equal right to treat of medicine.

7. Authority I have no pretence to. But reason is the common birthright of all. My reasons I have given in Siris. My motives every one will interpret from his own breast. But he must own himself a very bad man, who in my case, (that is, after long experience, and under full conviction of the virtues and innocence of tar water) would not have done as much. All men are, I will not say allowed, but obliged to promote the common benefit. And for this end, what I could not in conscience conceal, that I do and shall publicly declare, maugre all the spleen and raillery of a world, which cannot treat me worse than it hath done my betters.

8. As the morning's draught is most difficult to nice stomachs, such may lessen, or even omit it at the beginning, or rather postpone it till after breakfast, and take a larger dose at night; the distance from meal time need not be more than one hour for common stomachs, when the liquor is well clarified and skimmed. The oil that floated on the top and was skimmed off, should be carefully laid by, and kept for outward sores. In the variety of cases and constitutions, it is not amiss that there should be different manners of preparing and taking tar water. Trial will direct to the best: whether there be any difference between old tar or new tar, or which of all the various tars, produced from different trees, or in different parts of the world, is most medicinal, future trials must determine.

9. I have made a second sort of tar water, to be used externally, as a wash or lotion for the itch, scabs, ulcers, evil, leprosy, and all such foul cases, which I have tried with very good success, and recommend it to the trial of others. For inveterate cases of that kind, tar water should be drank, a quart every twenty-four hours, at four, six, or eight glasses: and after this hath been done at least for a fortnight, the lotion is to be applied outwardly, and warm, by bathing, fomenting, and steeping, and this several times in the twenty-four hours, to heal and dry up the sores, the drinking being still continued. This water, for external use, is made in the following manner: pour two quarts of hot boiling water on a quart of tar, stir and work it strongly with a flat stick or ladle, a full quarter of an hour; let it stand six hours, then pour it off, and keep it close covered for use. It may be made weaker or stronger as there is occasion.

10. From what I have observed of the lotion, I am inclined to think, it may be worth while in obstinate cutaneous ailments, leprosy, and weakness of limbs, to try a bath of tar water; allowing a gallon of tar to every ten gallons of boiling hot water; stirring the ingredients a full half hour; suffering the vessel to

stand eight or ten hours, before the water is poured off; and using the bath a little more than milk warm. This experiment may be made in different proportions of tar and water. In Dublin many cases occur for trial, which are not to be met with here in the country.

11. My experiments have been made in various cases, and on many persons; and I make no doubt its virtues will soon be more fully discovered, as tar water is now growing into general use, though not without that opposition which usually attends upon novelty. The great objection I find made to this medicine is, that it promises too much. What, say the objectors, do you pretend to a panacea, a thing strange, chimerical, and contrary to the opinion and experience of all mankind? Now to speak out, and give this objection or question a plain and direct answer, I freely own that I suspect tar water is a panacea. I may be mistaken, but it is worth trial: for the chance of so great and general a benefit, I am willing to stand the ridicule of proposing it. And as the old philosopher cried aloud, from the house-tops, to his fellow citizens, Educate your children; so, I confess, if I had a situation high enough, and a voice loud enough, I would cry out, to all the valetudinarians upon earth, Drink tar water.

12. Having thus frankly owned the charge, I must explain to you, that by a panacea is not meant a medicine which cures all individuals (this consists not with mortality), but a medicine that cures or relieves all the different species of distempers. And if God hath given us so great a blessing, and made a medicine so cheap and plenty as tar, to be with all so universal in its effects, to ease the miseries of human life, shall men be ridiculed or bantered out of its use, especially when they run no risk in the trial. For I can truly affirm, that I never knew any harm attend it more than sometimes a little nausea, which if the liquor be well cleared, skimmed, and bottled, need not I think be apprehended.

13. It must be owned I have not had opportunities of trying it myself in all cases, neither will I undertake to demonstrate *a priori*, that tar water is a panacea. But yet methinks I am not quite destitute of probable reasons, which, joined to what facts I have observed, induced me to entertain such a suspicion.

14. I knew tar was used to preserve cattle from contagion; and this may be supposed to have given rise to that practice of drinking tar water for a preservative against the small-pox. But as the tar water used for that purpose was made by mixing equal quantities of tar and water, it proved a most offensive potion; besides as a fresh glass of water was put in for each glass that was taken out, and this for many days on the same tar, it follows that the water was not equally impregnated with the fine volatile spirit, though all alike strongly satuarated with gross particles.

15. Having found this nauseous draught very useful against

the small-pox, to as many as could be prevailed on to take it, I began to consider the nature of tar. I reflected that tar is a balsam flowing from the trunks of aged evergreens; that it resists putrefaction; that it hath the virtues of turpentine, which in medicine are known to be very great and manifold; but I observed withal, that turpentines or balsams are very offensive in the taking: I therefore considered distinctly the several constituent parts of balsams; which were those, wherein the medicinal virtues resided, and which were to be regarded, rather as a viscous matrix to receive, arrest, and retain the more volatile and active particles; and if these last could be so separated and disengaged from the grosser parts, as to impregnate a clear and potable liquor, I concluded that such liquor must prove a medicine of great force, and general use. I considered, that nature was the best chymist and preparer of medicines, and that the fragrance and flavour of tar argued very active qualities and virtues.

16. I had, of a long time, entertained an opinion, agreeable to the sentiments of many ancient philosophers, that fire may be regarded as the animal spirit of this visible world. And it seemed to me that the attracting and secreting of this fire in the various pores, tubes, and ducts of vegetables, did impart their specific virtues to each kind; that this same light, or fire, was the immediate instrumental or physical cause of sense and motion, and consequently of life and health to animals; that on account of this solar light or fire, Phœbus was in the ancient mythology reputed the god of medicine. Which light as it is leisurely introduced, and fixed in the viscid juice of old firs and pines, so the setting it free in part, that is, the changing its viscid for a volatile vehicle, which may mix with water, and convey it throughout the habit copiously and inoffensively, would be of infinite use in physic, extending to all cases whatsoever, inasmuch as all distempers are in effect a struggle, between the *vis vitæ*, and the peculiar miasma, or *fomes morbi:* and nothing strengthens nature, or lends such aid and vigour to life, as a cordial which doth not heat.

17. The solar light in great quantity during the space of many successive years, being attracted and detained in the juice of ancient evergreens, doth form and lodge itself in an oil so fine and volatile, as shall mix well with water, and lightly pass the *primæ viæ*, and penetrate every part and capillary of the organical system, when once exempt and freed from the grosser nauseous resin. It will not, therefore, seem unreasonable, to whoever is acquainted with the medicinal virtues of turpentine in so many different distempers, for which it hath been celebrated both by ancient and modern physicians, and withal reflects on the nausea or clog that prevents their full operation and effect on the human body: it will not, I say, seem unreasonable to such a one to suppose, that if this same clog was removed, numberless cures might be wrought in a great variety of cases.

18. The desideratum was, how to separate the active particles from the heavy viscid substance which served to attract and retain them, and so to order matters, that the vehicle of the spirit should not on the one hand be volatile enough to escape, nor on the other gross enough to offend. For the performing of this, I have found a most easy, simple, and effectual method, which furnisheth a potable inoffensive liquor, clear and fine as the best white wine cordial and stomachic, to be kept bottled, as being endued with a very sensible spirit, though not fermented.

19. I tried many experiments as to the quantity of water, and the time of stirring and standing, in order to impregnate and clarify it, and, after all, fixed on the forementioned receipt, as the most generally useful for making this salutiferous liquor well impregnated, and not offensive to common stomachs, and even drank with pleasure by many: in which the most medicinal and active particles, that is, the native salts and volatile oil of the balsam, being disentangled and separated from its gross oil and viscous resin do, combined together, form a fine, balsamic, and vegetable soap, which not only can pass the stomach and *primæ viæ*, but also insinuate itself into the minutest capillaries, and freely pervade the whole animal system, and that, in such full proportion and measure, as suiteth every case and constitution.

20. The foregoing general considerations put me upon making experiments in many various and unlike cases, which otherwise I should never have thought of doing, and the success answered my hopes. Philosophical principles led me to make safe trials, and on those trials is founded my opinion of the salutary virtues of tar water; which virtues are recommended from, and depend on experiments and matters of fact, and neither stand nor fall with any theories or speculative principles whatever. Howbeit, those theories, as I said, enlarged my views of this medicine, led me to a greater variety of trials, and thereby engendered and nourished my suspicion that it is a panacea. I have been the more prolix in these particulars, hoping that, to as many as shall candidly weigh and consider them, the high opinion I conceive of this medicine will not seem altogether an effect of vain prepossession or blind empiric rashness, but rather the result of free thought and inquiry, and grounded on my best reason, judgment, and experience. Much complaint is indeed made of the iniquity of the times. However, it is hoped they will not condemn one man's tar water for another's pill or drop, any more than they would hang one man for another's having stolen a horse.

21. Those who have only the good of mankind at heart will give this medicine fair play; if there be any who act from other motives, the public will look sharp and beware. To do justice to tar water, as well as to those who drink it, regard must be had to the particular strength and case of the patients. Griev-

ous or inveterate maladies must not be treated as common cases. I cured a horrible case, a gangrene in the blood, which had broke out in several sores, and threatened speedy death, by obliging the person to drink nothing but this liquor for several weeks, as much and as often as his stomach would bear. Common sense will direct a proportionable conduct in other cases. But this must be left to the conscience and discretion of the givers and takers.

22. After all that can be said, it is most certain that a panacea sounds odd, and conveys somewhat shocking to the ear and sense of most men, who are wont to rank the universal medicine with the philosopher's stone and the squaring of the circle; whereof the chief, if not sole reason, I take to be, that it is thought incredible the same thing should produce contrary effects, as it must do if it cures opposite distempers. And yet this is no more than every day's experience verifies. Milk, for instance, makes some costive and others laxative: this regards the possibility of a panacea in general; as for tar water in particular, I do not say it is a panacea, I only suspect it to be so; time and trial will show.

23. But I am most sincerely persuaded, from what I have already seen and tried, that tar water may be drank with great safety and success, for the cure or relief of most, if not all diseases; of ulcers, itch, scald-heads, leprosy, the foul disease, and all foul cases, scurvies of all kinds, disorders of the lungs, stomach, and bowels, in rheumatic, gouty, and nephritic ailments, megrims, inveterate head aches, pleurisies, peripneumonies, erysipelas, small-pox, and all kinds of fevers, colics, hysteric and all nervous cases, dropsies, decays, and other maladies. Note, that for agues it should be drank warm, and often, in small glasses, both in and out of the fit, and continued for several days, to prevent a relapse. Nor is it of use only in the cure of sickness, it is also useful to preserve health, and guard against infection, and in some measure even against old age, as it gives lasting spirits, and invigorates the blood. I am even induced by the nature and analogy of things, and its wonderful success in fevers of all kinds, to think that tar water may be very useful against the plague, both as a preservative and a cure.

24. But I doubt no medicine can withstand that execrable plague of distilled spirits, which do all, without exception (the fire of the hot still imparting a caustic and coagulating quality to all distilled spirits, whatever the subject or ingredients may be), operate as a slow poison, preying on the vitals, and wasting the health and strength of body and soul: which pest of human kind is, I am told, gaining ground in this country, already too thin of inhabitants.

I am, &c.

FARTHER THOUGHTS ON TAR WATER.

A SECOND LETTER TO T. P., Esq.

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1. YOUR attention to whatever promotes the public good of your country, or the common benefit of mankind, having engaged you in a particular inquiry concerning the virtues and effects of tar water, you are entitled to know what farther discoveries, observations, and reflections, I have made on the subject.

2. Tar water, in the several editions of Siris, hath been directed to be made by stirring three, four, five, or six minutes, a gallon of water and a quart of tar. But although it seem best made, for general use, within those limits, yet the stomach of the patient is the best rule whereby to direct the strength of the water; with a little more stirring, six quarts of good tar water may be made from one of tar; and with eight minutes' stirring, I have known a gallon of tar water produced from second-hand tar, which proved a good remedy in a very bad fever, when better tar could not be had. For the use of travellers, a tar water may be made very strong, for instance, with one quart of water, and a quart of tar, stirred together for the space of five minutes. A bottle of this may serve long on a road, a little being put to each glass of common water, more or less, as you would have it stronger or weaker. Near two years ago, a quart of about this strength was given to an old woman, to be taken at one draught by direction of a young lady, who had consulted one in my family about the method of preparing and giving tar water, which yet she happened to mistake. But even thus it did service in the main, though it wrought the patient violently all manner of ways: which shows that errors and excesses in tar water are not so dangerous as in other medicines.

3. The best tar I take to be that which is most liquid, or first running from the billets of fir or pine, which grew on the mountains: it hath a greater share of the anti-scorbutic vegetable juices, which are contained not only in the leaves and tender tops, but in all parts of the wood; and these, together with the salts of woodsoap, being in the composition of tar superadded to turpentine, render tar water a medicine, if I am not mistaken, much more extensive and efficacious than any that can be obtained from turpentine alone.

4. The virtues of the wood juices show themselves in spruce-beer, made of molasses, and the black spruce-fir in the northern parts of America; and the young shoots of our common spruce-fir have been put to malt liquor in my own family, and make a very wholesome drink.

5. Tar water seldom fails to cure, or relieve, when rightly made of good tar, and duly taken. I say of good tar, because the vile practice of adulterating tar, and of selling the dregs of tar, or used tar for fresh, is grown frequent, to the great wrong of those who take it. Whoever hath been used to good tar water can readily discern the bad by its flat taste, void of that warm, cordial quality found in the former; it may also be expedient for knowing fresh tar, to observe, whether a fat oily scum floats on the top of the water, which is found to be much less, if any at all, on the second making of tar water. This scum was directed to be taken out, not from its being apt to do harm when drank, but to render the tar water more palatable to nice stomachs. Great quantities of tar are produced in Germany, Italy, and other parts of the world. The different qualities or virtues of these it may be worth while to try, and I wish the trial were made principally by observing, which giveth most sense of a lively, cordial spirit upon drinking the water.

6. This medicine of tar water worketh various ways, by urine, by perspiration, as a sudorific, carminative, cardiac, astringent, detergent, restorative, alterative, and sometimes as a gentle purgative or emetic, according to the case and constitution of the patient, or to the quantity that is taken; and its operation should not be disturbed. I knew two brothers ill of a fever about the same time; it wrought on the one by copious sweating, on the other altogether by urine; and I have known it to act at different times differently, even on the same person, and in the same disorder; one while as a diaphoretic, or sudorific, another as a diuretic. Its general character is diuretic, which shows, that it cleanseth the urinary passages, preventing thereby both stone and gravel, against which it hath been found very useful, and much safer than mineral waters, by reason of its balsamic healing quality.

7. Tar water doth recover and impart vital heat, but imparts no inflaming heat. I have seen a wonderful cure wrought on a child about eight years old, and past all hopes, by pouring several spoonfuls of tar water down his throat, as he lay quite subdued by a most violent fever, without any appearance of sense or motion, the nostrils drawn back, the eyes fixed, the complexion deadly wan. And yet tar water, forced down by spoonfuls, seemed to kindle up life a-new; and this after sage-tea, saffron, milk-water, Venice treacle, &c., had been used without any success.

8. This is of itself a sufficient cordial, friendly and congenial to the vital heat and spirits of a man. If therefore strong liquors are in the accustomed quantity superadded, the blood being already, by tar water, sufficiently warmed for vital heat, the strong liquors superadded will be apt to over-heat it, which over-heating is not to be imputed to the tar water, since, taken alone, I could never observe it attended with that symptom.

9. And though it may be no easy matter to persuade such as have long indulged themselves in the free use of strong fermented liquors and distilled spirits, to forsake their pernicious habits, yet I am myself thoroughly persuaded, that in weakness or fatigue of body, or in low spirits, tar water alone doth far surpass all those vulgarly esteemed cordials, which heat and intoxicate, and which coagulate the fluids, and, by their caustic force, dry up, stiffen, and destroy the fine vessels and fibres of the unhappy drinkers, obstructing the secretions, impairing the animal functions, producing various disorders, and bringing on the untimely symptoms of old age. Nothing doth so much obstruct the good effects of tar water, as the abuse of strong liquors. Where this is avoided, it seems no chronical malady can keep its ground, or stand before tar water constantly and regularly taken, not even hereditary distempers, as the most inveterate king's-evil, nor even the most confirmed gout; provided it be drank a quart a day, at six or eight glasses, and at all seasons, both in and out of the fit, and that for a great length of time, the longer the better. It is to be noted, that in fits of the gout, colic, or fever, it should be always drank warm. On other occasions, warm or cold, as the patient likes.

10. The inference I make is, that those who expect health from tar water, have less need of any other cordial, and would do well to sacrifice some part of their pleasure to their health. At the same time I will venture to affirm, that a fever produced either from hard drinking, or any other cause, is most effectually and speedily subdued, by abstaining from all other cordials, and plentifully drinking of tar water; for it warms the cold, and cools the hot; simple water may cool, but this, at the same time that it cools, gives life and spirit. It is, in truth, a specific for all kinds of fevers; the same medicine, which is a leisurely alterative in chronical disorders, being taken in larger quantities, is a speedy cure in acute ones.

11. Those who, without knowledge or experience of tar water, have been so active and earnest to discredit its virtues, have much to answer for, especially with regard to acute inflammatory distempers, in which it doth wonders. It is in those disorders, so fatal and frequent, that I have had most opportunities of observing its virtues, nor can the world ever know the just value of this medicine, but by trying it in the like cases.

12. When patients are given over, and all known methods fail, it is allowed to try new remedies. If tar water was tried in such cases, I do verily believe, that many patients might thereby be rescued from the jaws of death: particularly, I would recommend the trial of it, in the most malignant and desperate fevers or small-pox, attended with purple, livid, or black spots. It is my sincere opinion, that warm tar water, drank copiously, may often prove salutary, even in those deplorable cases.

13. My opinion is grounded on its singular virtues in correcting, sweetening, and invigorating the blood, and in curing cancers and gangrenes, or beginning mortifications, such as those spots do indicate. I have lately known it drunk with good success in a very painful and unpromising wound; and am persuaded, that if it were drank plentifully, during the dressing of all sorts of dangerous wounds, it might assuage the anguish, and forward the cure; as it abates feverish symptoms, and by rendering the blood balsamic, and disposing the parts to heal, prevents a gangrene.

14. Tar itself is an excellent medicine, being spread on a cloth, and applied warm to an ulcer or wound. I have known the same applied to a very large and painful tumour, caused by a sprain or bruise, speedily assuage the pain, and reduce the swelling. I may add, that tar (mixed with honey to make it less offensive, and) taken inwardly, is an admirable balsam for the lungs; and a little of this, taken together with tar water, hastens its effect in curing the most obstinate and wasting coughs; and an egg-shell full of tar, swallowed and washed down with a quart of tar water, night and morning, hath been found very useful for the same disorder in horses.

15. Sitting over the vapour of the heated lotion, described in my former letter, is excellent in the cases of piles or fistula; especially if fomenting with the same lotion be added, as also anointing with the oil scummed from the top of tar water. Tar water hath been snuffed up the nostrils, with good success, for a great heaviness of the head and drowsiness. It is a very useful wash for weak, dry, or itching eyes; an excellent preservative for the teeth and gums; also a good drink and gargle for a sore throat: I may add, that I have known it succeed in cases where it has been tried without hopes of success, particularly in deafness. I have known life sustained many days together, only by drinking of tar water, without any other nourishment, and without any remarkable diminution of strength and spirit; it may therefore be of singular use, and save many lives in the distress of famine at sea, or in sieges, and in seasons of great scarcity. The virtue of tar water flowing like the Nile,* from a secret and

* The Nile was by the ancient Egyptians called Siris, which word also signifies, in Greek, a chain, though not so commonly used as Sira.

occult course, brancheth into innumerable channels, conveying health and relief, wherever it is applied; nor is it more easy and various in its use, than copious in quantity. How great havoc, nevertheless, is made by the small-pox, raging like a plague, in New England, and other parts of America, which yet abound with tar! and how many thousand sailors, in all parts of the world, are rotting by the scurvy with their remedy at hand!

16. Many in this town of Cloyne have, by the copious drinking of tar water alone, been recovered of the most violent fevers, attended with the most threatening symptoms, and much heightened by relapses from mismanagement. It would be tedious to enumerate all the cases of this kind which have happened at Cloyne and in my own family; where many fevers, pleuritic, as well as others, attended with violent stitches, difficulty of breathing, and spitting of blood, have been cured by tar water; and this I can with truth affirm, that I never knew it regularly tried, in any inflammatory case, without success: but then it must be given in bed warm, and very copiously, with all due caution against cold, noise, and improper diet.

17. I have often observed, when a patient, on the first attack of a fever, hath betaken himself to his bed, and drank tar water regularly and constantly; that he hath had such favourable symptoms, so good appetite, and so sound sleep, that the fever passed almost as nothing; nor was to be distinguished otherwise than by a quickness of pulse, a little feverish heat, and thirst. The more that patients in a fever drink, the better they find themselves; and their liking to tar water grows with their want of it, by a certain instinct or dictate of nature; insomuch, that I have known children, in very high fevers, who, at other times, could hardly be prevailed on to drink a single glass, drink six or eight in an hour.

18. I can truly affirm, that for the cases within my own observation, inflammatory acute distempers cured by tar water, have been, at least, ten times the number of any other. These, indeed, oftenest occur, as causing the chief destruction and general ravage of mankind; who are consequently debarred from the principal use and benefit of this medicine, so long as they give ear to the suggestions of those, who, without any experience thereof, would persuade them, it is of an heating or inflaming nature; which suggestion, as I am convinced myself, by long and manifold experience, that it is absolutely false, so may all others also be sufficiently convinced of its falsehood, by the wonderful fact attested by a solemn affidavit of captain Drape, at Liverpool; whereby it appears, that of 170 negroes, seized at once by the small-pox on the coast of Guinea, one only died, who refused to drink tar water; and the remaining 169, all recovered by drinking it, without any other medicine,

notwithstanding the heat of the climate, and the incommodities of the vessel. A fact so well vouched must, with all unbiassed men, outweigh the positive assertions of those who have declared themselves adversaries of tar water, on the score of its pretended heating or inflaming quality.

19. The skill and learning of those gentlemen in their profession I shall not dispute; but yet it seems strange that they should, without experience, pronounce at once, concerning the virtues of tar water, and ascribe to it pernicious qualities, which I, who had watched its workings and effects for years together, could never discover. These three last years I have taken it myself without one day's intermission; others in my family have taken it near the same time, and those of different ages and sexes; several in the neighbourhood have done as much, all without any injury, and with much benefit.

20. It is to be noted, the skin and the belly are antagonists; that is, the more passeth by perspiration, the less will pass another way. Medicines, therefore, which cause the patient to perspire, will be apt to make him costive. Therefore, when tar water worketh much by perspiration, the body may chance to be bound. But such symptom, though it should be attended with a little more than ordinary warmth, need not be dreaded by the patient; it being only a sign, that his cure is carried on by driving the peccant matter through the skin; which is one of the ways whereby tar water worketh its effect. And when this effect or cure is wrought, the body of itself returneth to its former natural state; and if some have been bound in their bodies, I have known others affected in a contrary manner upon drinking tar water, as it hath happened to operate, either in the shape of a diaphoretic or of a gentle opening medicine. I have even known a costive habit more than once removed by it, and that when the case was inveterate, and other methods had failed.

21. I mentioned the foregoing article, upon calling to mind, that two or three patients had, for a time, complained of a binding quality in tar water. I likewise remember, that one in a high degree of the scurvy was discouraged from the use of tar water, by its having caused an uneasy itching all over his body. But this was a good symptom, which showed the peccant humours to be put in motion, and in a fair way of being discharged through the skin.

22. A humour or flatus put in motion, and dislodged from one part, often produceth new pains in some other part; and an efficacious medicine, as it produceth a change in the economy, may be attended with some uneasiness, which yet is not to be accounted a distemper, but only an effect or symptom of the cure.

23. The salts of tar water have nothing of the fiery and corrosive nature of lixivial salts produced by the incineration of the

subject; they not being fixed salts, made by the extreme force of fire, but volatile salts, such as pre-existed in the vegetable and would have ascended in smoke, if not prevented by the sod or covering of the billet piles. This, though already hinted in Siris, and plain from the manner of making tar, I have thought fit to repeat and inculcate, because, if duly attended to, it may obviate suspicions about tar water, proceeding only from an ignorance of its nature.

24. Every step that I advanced in discovering the virtues of tar water, my own wonder and surprise increased, as much as theirs to whom I mentioned them: nor could I, without great variety and evidence of facts, ever have been induced to suspect, that, in all sorts of ailments whatsoever, it might relieve or cure, which at first sight may seem incredible and unaccountable; but, on maturer thought, will perhaps appear to agree with, and follow from the nature of things. For it is to be noted, that the general notion of a disease seemeth to consist in this, that what is taken in, is not duly assimilated by the force of the animal economy; therefore it should seem, whatever assists the *vis vitæ* may be of general use in all diseases, enabling nature either to assimilate, or discharge all unsubdued humours and particles whatsoever. But the light or ether detained on the volatile oil, which impregnates tar water, being of the same nature with the animal spirit, is an accession of so much strength to the constitution, which it assists to assimilate or expel whatever is alien or noxious.

A LETTER TO T. P. ESQ.;

CONCERNING

THE USEFULNESS OF TAR WATER IN THE PLAGUE.

WHEREIN ALSO IT IS CONSIDERED,

WHETHER TAR WATER PREPARED WITH THE DISTILLED ACID OF TAR SHOULD BE PREFERRED TO THAT MADE IN THE COMMON WAY, BY MIXING TAR WITH WATER, AND STIRRING THEM TOGETHER.

YOU observed in a late letter of yours, that I had formerly hinted tar water might be useful in the plague, and desire to know the reasons whereon my opinion was grounded, and that I would communicate my thoughts at large on the subject; I am the more willing to satisfy you in this particular, as the plague now raging in Barbary hath in some measure alarmed the public, and I think it may not be amiss to contribute my mite of advice towards averting or lessening the present danger; and, as fear begets caution, to possess my countrymen with an apprehension of this the greatest of all temporal calamities, sufficient to put them on their guard, and prepare them against the worst that can happen.

A learned physician of our own observes, that the plague does not visit these Britannic islands oftener than once in thirty or forty years, and it is now above twice that time since we felt the hand of the destroying angel.

It is also the opinion of physicians, that the infection cannot spread, except there is a suitable disposition in the air to receive it; the signs of which are wet summers, leaves and fruits blasted, an unusual quantity of insects, epidemical distempers among the cattle, to which I presume may be added long easterly winds, all which signs seem to have discovered themselves pretty plainly in the course of this present year.

Beside these natural forerunners of a plague or pestilence in the air, it is worth observing, that a prognostic may be also made from the moral and religious disposition of the inhabitants. Certainly that the *digitus dei* (the τὶ θεῖον of Hippocrates) doth manifest itself in the plague, was not only the opinion of mankind in general, but also in particular of the most eminent physicians throughout all ages down to our own. How far we of these

islands have reason to expect this messenger of divine vengeance, will best appear if we take a view of the prevailing principles and practices of our times, which many think have long called aloud for punishment or amendment.

Analogy and probability prevail in medicine: these are the proper guides where experience hath not gone before. I knew that tar water was useful to prevent catching the small-pox, and consequently that its nature was contrary to the taint or venom producing that distemper, and therefore I concluded, that it might be usefully applied to cure the same, though I never heard nor knew that it had been applied to that purpose, and the success answered my hopes.

In like manner, having known the virtue of tar water in preserving from epidemical infection, I conceive in general it may be useful for the cure of distempers caused by such infection. Besides, being very well assured that tar water was sovereign in the cure of all sorts of fevers, I think it not unreasonable to infer, that it may prove a successful medicine for the plague, although I have never known it used in that distemper, forasmuch as the plague, with all its symptoms, may be considered as a species of fever, and hath been actually considered as such both by Hippocrates and Sydenham, not to mention others.

Having observed surprising effects of tar water in the most deplorable cases, for instance, pleurisies, small-pox, spotted and erysipelatous fevers, I am induced to entertain great hopes of its success in pestilential fevers or plagues; which are also confirmed by its operating as a powerful diaphoretic and sudorific, when given warm and in great quantities. Add to this, that it frequently throws out pustules and ulcers, and is apt to terminate the worst of fevers by an irruption of boils in various parts of the body; that it raises the spirits, is a great alexipharmacum and cordial, and must therefore be of the greatest use in malignant cases.

In cachexy, scurvy, gout, as well as in the close of fevers, I have often known tar water cause troublesome eruptions or boils (the very method taken by nature in casting forth the venom of the plague) to break out in the surface of the body, expelling the morbific humours, the cause and relics of the disease, to the signal benefit of the patients; except such who, being frightened at the symptoms, have supposed the tar water to produce those humours which it only drives out, and in consequence of such, their groundless suspicion, laid it aside, or perhaps took other medicines to hinder its effect, and thereby deprived themselves of the benefit they might otherwise have received.

In the plague are observed head-ache, drowsiness, anxiety, vigils, sinking of spirits, and weakness, for all which tar water hath been found an effectual remedy. Bloody urine and spitting

blood, which are also dangerous symptoms observed in the plague, have been often removed by the same medicine, which from numberless experiments I have found to be peculiarly fitted for purifying and strengthening the blood, and for giving it a due consistence, as well as a proper motion.

In the plague, pleurisies are esteemed mortal symptoms, and in the cure of these, I never knew tar water fail, if given warm in bed, a pint or more an hour, though the patient was neither bled nor blistered. The carbuncles and spots which show themselves in the plague are of a gangrenous nature, tending to mortification. And gangrenes I have known effectually cured by copious drinking of tar water.

An erysipelas, which showeth a degree of malignity nearest to the plague, is easily cured by plentiful drinking of tar water. I knew a person who had been six weeks ill of an erysipelas under the care of a celebrated physician, during which time she struggled with many dangerous symptoms, and hardly escaped with life. This person was a year after seized again in the same manner, and recovered in a week by the sole use of tar water. Costiveness is reckoned a very hopeful prognostic in the plague; and it is also a symptom which often attends the drinking of tar water, when it throws out the venom of a distemper through the skin.

Diseases of the same season generally bear some affinity to each other in their nature and their cure; and it may not be improper on this occasion to observe, that the reigning distemper of the black cattle hath been often cured by tar water, and would (I am persuaded) have done much less mischief, if the practice had been general to have given each distempered beast three gallons the first, two the second, and one the third day, in warm doses (from a pint to a quart), and at equal intervals.

Diemerbroeck recommends, in the first appearance of a plague, the use of sudorifics, putting the patient to bed, and covering him warm, till a copious sweat be raised, the very method I constantly follow in the beginning of fevers, using no other medicine than tar water, which, after numberless experiments, I take to be the best sudorific that is known, inasmuch as it throws out the morbific *miasma*, without either heating the patient or weakening him, the common effects of other sudorifics; whereas this, at the same time that it allays the feverish heat, proves a most salutary cordial, giving great and lasting spirits.

Upon the whole, I am sincerely persuaded, that for cure of the plague there cannot be a better method followed, more general for use, more easy in practice, and more sure in effect, than to cover the patient warm in bed, and to make him drink every hour one quart of warm tar water, of such strength as his stomach is able to bear; a thing not so impracticable as it may

seem at first sight, since I have known much more drank in fevers even by children, and that eagerly and by choice, the distemper calling for drink, and the ease it gave encouraging to go on. This for the cure; but I conceive that one quart *per diem* may suffice for prevention; especially if there be added an even temper of mind, and an exact regimen, which are both highly useful against the plague. For carbuncles and buboes I would recommend a liniment of the oil of tar, or a plaister of pitch mixed with tar, which last was used by the vulgar in the Dutch plague described by Diemerbroeck.

It has pleased divine providence to visit us not long since, first, with famine, then with the sword; and if it shall please the same good providence yet further to visit us for our sins, with the third and greatest of human woes, this by God's blessing, is the course I mean to take for myself and family; and if generally practised, it would, I doubt not, (under God) save the lives of many thousands; whereof being persuaded in my own mind, both from the many trials I have made of tar water, and the best judgment and reasonings I could form thereupon, I think myself obliged to declare to the world what I am convinced of myself.

And I am rather moved to this by the great uncertainty and disagreement among physicians, in their methods of treating the plague. Diemerbroeck, for instance, a physician of great experience in the Dutch plague, that raged about eighty years ago, dissuades by all means from bleeding in that distemper. On the other hand, Sydenham recommends what the other disapproves. If we believe Dr. Sydenham, the free use of wine, as a preservative, hath thrown many into the plague, who otherwise might have escaped. Dr. Willis on the contrary avers, that he knew many, who being well fortified by wine, freely entered amongst the infected, without catching the infection.

Bleeding cools, but at the same time weakens nature: wine gives spirits, but heats withal. They are both therefore to be suspected; whereas tar water cools without weakening, and gives spirits without heating, a sure indication of its sovereign virtue in all inflammatory and malignant cases, which is confirmed by such numbers of instances, that matter of fact keeps pace (at least) with reason and argument in recommending this medicine.

Plagues as well as fevers are observed to be of different kinds; and it is observed of fevers, that as they change their genius in different seasons, so they must be treated differently, that very method that succeeded in one season often proving hurtful in another. Now it is very remarkable, that tar water has been known to vary its working, and wonderfully adapt itself to the particular case of the patient, a thing I frequently have experienced.

Last spring two children, a boy and a girl, the former ten years old, the latter eight years old, were seized with fevers; the boy had an inflammation in his breast. In less than two hours they drank each about five quarts of warm tar water, which wrought them very differently, the girl as an emetic, the boy as a gentle purge, but both alike immediately recovered, without the use of any other medicine: of this I was an eye witness, and I have found by frequent experience, that the best way is, to let this medicine take its own course, not hindered nor interrupted by any other medicines; and this being observed, I never knew it to fail so much as once, in above a hundred trials in all sorts of fevers.

Nevertheless there are not wanting those who would insinuate, that tar water made in the common way contains noxious oils or particles of tar, which render it dangerous to those who drink it, a thing contrary to all my experience. This was the old objection made by those who opposed it from the beginning. But I am convinced by innumerable trials, that tar water is so far from doing hurt by any caustic or fiery quality, that it is on the contrary a most potent medicine for the allaying of heat, and curing of all inflammatory distempers. The perpetual returning to the same objection makes it necessary to repeat the same answer.

And yet some who are not afraid to argue against experience, would still persuade us that the common tar water is a dangerous medicine, and that the acid freed from the volatile oil is much more safe and efficacious: but I am of opinion, that being robbed of its fine volatile oil (which neither sinks to the bottom nor floats at the top, but is throughout and intimately united with it, and appears to the eye only in the colour of tar water); being robbed, I say, of this oil, it is my opinion it can be no cordial, which opinion (not to mention the reason of the thing) I ground on my own experience, having observed that the most acid water is the least cordial, so far am I from imputing the whole virtue to the acid, as some seem to think.

It seems not very reasonable to suppose, that the caustic quality of tar water (if such there was) should be removed or lessened by distillation, or that a still should furnish a cooler and better medicine than that which is commonly prepared by the simple affusion and stirring of cold water. However the ends of chymists or distillers may be served thereby, yet it by no means seemeth calculated for the benefit of mankind in general, to attempt to make people suspect, and frighten them from the use of a medicine, so easily and so readily made, and every where at hand, of such approved and known safety, and at the same time recommended by cures the most extraordinary, on persons of all sexes and ages, in such variety of distempers, and in so many distant parts of christendom.

By most men, I believe, it will be judged at best, a needless undertaking, instead of an easy tried medicine to introduce one more operose and expensive, unsupported by experiments, and recommended by wrong suppositions, that all the virtue is in the acid, and that the tar water being impregnated with volatile oil is caustic, which are both notorious mistakes.

Though it be the character of resin not to dissolve and mix with water as salts do, yet these attract some fine particles of essential oil, which serve as a vehicle for such acid salts; and the colour of the tar water showeth the fine oil, in which the vegetable salts are lodged, to be dissolved and mixed therein. The combination of two such different substances as oil and salt, constitutes a very subtile and active medicine, fitted to mix with all humours, and resolve all obstructions, and which may properly be called an acid soap.

Tar water operates more gently and safely, as the acid salts are sheathed in oil, and thereby losing their acrimony, approach the nature of neutral salts, and so become more friendly to the animal system. By the help of a smooth insinuating oil, these acid salts are more easily and safely introduced into the fine capillaries. I may add, that the crasis of the blood is perfected by tar water, being good against too great a solution and fluidity as a balsam, and against viscidity as a soap, all which entirely depends upon the mixture of oil with the acid, without which it could neither operate as a balsam nor a soap; briefly, it was not mere acid or distilled water, or tincture of tar, but tar water as commonly made, by affusion and stirring of cold water upon tar, which hath wrought all those great cures and salutary effects, which have recommended it as a medicine to the general esteem of the world.

The mixture of volatile oil, which is or contains the spirit, is so far from noxious, that it is the very thing that makes tar water a cordial; this gives it a grateful warmth, and raiseth the spirits of the hysteric and hypochondriacal; this also rendering the blood balsamic, disposeth wounds of all sorts to an easy cure; this also it is that fortifies the vitals and invigorates nature, driving the gout to the extremities, and shortening the fits, till it entirely subdues that obstinate and cruel enemy, as it hath been often known to do; but acid alone is so far from being able to do this, that, on the contrary, the free use of acids is reckoned amongst the causes of the gout.

I never could find that the volatile oil drawn from tar by the affusion of cold water produced any inflammation, or was otherwise hurtful, not even though the water by longer stirring had imbibed far more of the oil than in the common manner, having been assured, that some of strong stomachs have drank it after twenty minutes' stirring, without any the least harm, and with very great benefit.

It hath been indeed insinuated, that the oil was ordered to be skimmed off, because it is caustic and dangerous; but this is a mistake. I myself, among many others, drank the tar water for two years together, with its oil upon it, which never proved hurtful, otherwise than as being somewhat gross, and floating on the top, it rendered the water less palatable, for which reason alone it was ordered to be skimmed.

It hath also been hinted, that making tar water the second time of the same tar was cautioned against, for that it was apprehended such water would prove too heating; which is so far from being true, that when I could not get fresh tar, I used the second water without difficulty, by means whereof it pleased God to recover from the small-pox two children in my own family, who drank it very copiously, a sufficient proof that it is not of that fiery caustic nature which some would persuade us.

The truth is, my sole reason for advising the tar not to be used a second time, was because I did not think it would sufficiently impregnate the water, or render it strong enough after so much of the fine volatile parts had been carried off by the former infusion. Truth obligeth me to affirm, that there is no danger (forasmuch as I could ever observe) to be apprehended from tar water, as commonly made; the fine volatile oil, on which I take its cordial quality to depend, is in its own nature so soft and gentle, and so tempered by the acid, and both so blended and diluted with so great a quantity of water, as to make a compound, cherishing and cordial, producing a genial, kindly warmth, without any inflaming heat, a thing I have often said, and still find it necessary to inculcate.

Some medicines indeed are so violent that the least excess is dangerous; these require an exactness in the dose, where a small error may produce a great mischief. But tar is, in truth, no such dangerous medicine, not even in substance, as I have more than once known it taken innocently, mixed with honey, for a speedy cure of a cold.

But notwithstanding all that hath been said on that subject, it is still sometimes asked, what precise quantity or degree of strength is required? To which I answer (agreeably to what hath been formerly and frequently observed) the palate, the stomach, the particular case and constitution of the patient, the very climate or season of the year, will dispose and require him to drink more or less in quantity, stronger or weaker in degree; precisely to measure its strength by a scrupulous exactness is by no means necessary. Every one may settle that matter for himself with the same safety that malt is proportioned to water in making beer, and by the same rule, to wit, the palate.

Only in general thus much may be said, that the proportions I formerly recommended will be found agreeable to most sto-

machs, and withal of sufficient strength, as many thousands have found, and daily find, by experience. I take this opportunity to observe, that I use tar water made in stone-ware or earthen, very well glazed, earthen vessels unglazed being apt to communicate a nauseous sweetness to the water.

Tar water is a diet-drink, in the making whereof there is great latitude, its perfection not consisting in a point, but varying with the constitution and palate of the patient, being nevertheless, at times, taken by the same person, weaker or stronger, with much the same effect, provided it be proportionably in greater or lesser quantity. It may indeed be so very weak as to have little or no effect; and, on the other hand, so very strong as to offend the stomach; but its degree of strength is easily discerned by the colour, smell, and taste, which alone are the natural and proper guides whereby to judge thereof; which strength may be easily varied, in any proportion, by changing the quantity either of tar or water, or the time of stirring. As for setting tar water to stand, this is not to make it stronger, but more clear and palatable.

I found myself obliged to assert the innocence and safety, as well as usefulness, of the tar water, as it is commonly made, by the methods laid down in my former writings on this subject; and this not only in regard to truth, but much more in charity to a multitude, which may otherwise perhaps be influenced by the authority of some, who endeavoured to put them out of conceit with a medicine so cheap, so efficacious, and so universal, by suggesting and propagating scruples about a caustic quality arising from the volatile, oily particles of tar or resin, imbibed together with the acid in making tar water; an apprehension so vain, that the reverse thereof is true, for which I appeal to the experience of many thousands, who can answer for the innocence and safety, as well as efficacy of this medicine, of which there are such ample and numerous certificates published to the world.

I shall finish my essay on the plague and its cure with observing, that in case God should withhold his hand for the present, yet these reflections will not be altogether fruitless, if they dispose men to a proper temper of mind, and a cautious regimen, avoiding all extremes, which things are justly reckoned among the chief preservatives against infection; but especially if the apprehension of this destroyer shall beget serious thoughts on the frailty of human life, and, in consequence thereof, a reformation of manners; advantages that would sufficiently repay the trouble of writing and reading this letter, even though the trial of tar water, as a remedy for the plague, should be postponed (as God grant it may) to some future and distant opportunity.

FARTHER THOUGHTS,

ETC.

As the many experiments that are daily made of the virtues of tar water, furnish new discoveries and reflections, some of these I have thrown together, and offer to the public, in hopes they may prove useful.

It is a frequent complaint, that tar water is made of bad tar, being of a reddish colour, sweetish, or disagreeably insipid. But though the dregs of tar are often foul, and make foul tar water; and though tar already used is often made use of by unfair dealers a second, if not a third time, which produceth a vile potion, void of the genuine flavour and virtue of tar water: yet I apprehend these defects may sometimes be ascribed, rather to the vessel wherein the tar water is made, than to the tar itself.

Tar water being made in an earthen vessel unglazed, or that hath lost part of its glazing, may extract (as it is a strong menstruum) from the clay, a fade sweetishness, offensive to the palate. It should seem, therefore, that the best way of making tar water is in a stone jug or earthen vessel, throughout well glazed, and, as it will not fail to extract a tincture from any metallic vessel, it should be warmed in a well glazed pipkin, rather than a saucepan.

By increasing the proportion of tar to the water, and by stirring it longer, tar water may be made strong enough for a spoonful to impregnate a large glass, a thing very useful on a road.

Those who in chronical disorders, or as a preservative, have for a long time drank tar water, must, in acute cases, drink the more.

Tar water must be drank warm in agues, small-pox, measles, and fevers, in colics and disorders of the bowels, in gout also, and rheumatism, in most other ailments cold or warm, at the choice of the patient.

In fevers the patient cannot begin too soon, or drink too much. By undoubted experience it is found to cool the hot, and warm the cold, and to be a most successful medicine in fevers, notwithstanding its great virtue in palsies and dropsies.

When not long since an inflammation attacked the throat, breast, and lungs of children, and became general in my neighbourhood, numbers were recovered by the use of tar water, nor

did I hear that any miscarried who used it, though many perished who did not.

Nor is it a medicine less proper and efficacious in old age. At the same time that this inflammatory distemper raged among the children, a woman, in her sixty-eighth year, from violent cold, was seized at once with ague, colic, and jaundice, of all which maladies she was cured in a fortnight, by drinking three pints of warm tar water every day. Numberless such instances daily occur, which show it to be a safe and efficacious medicine, both for old and young.

Evacuations by sweat, which usually render patients very weak and dispirited, have not the same bad effects when produced by tar water, which I have frequently known to give high spirits in all the stages of a fever, and under the lowest regimen, therefore old people and weak persons, who cannot well bear common evacuations, are best cured by tar water, which, in some sort, seemeth to renew those who are worn out with age and infirmities.

Tar water is of singular use in strengthening the stomach and bowels, and agrees particularly well with infants, taken either by themselves or by the nurse, and best by both. Though as it throws the ill humours out into the surface of the skin, it may render them for a time, perhaps, unseemly with eruptions, but withal healthy and lively. And I will venture to say, that it lays in them the principles of a good constitution for the rest of their lives.

Nor is it only useful to the bodies of infants, it hath also a good effect on their minds, as those who drink it are observed to be remarkably forward and sprightly. Even the most heavy, lumpish, and unpromising infants, appear to be much improved by it. A child there is in my neighbourhood, of fine parts, who at first seemed stupid and an idiot, but, by constant use of tar water, grew lively and observing, and is now noted for understanding beyond others of the same age.

Infants are easily brought to take it by spoon, and even grow to a liking of it, and as their disorders arise chiefly from indigestion, they receive the greatest benefit from a medicine so well calculated to strengthen the intestines, and preserve them from fits. In a word, if it were the common practice to accustom infants from the beginning to take tar water, this would greatly conduce to the health both of their minds and bodies. There is, I am verily persuaded, no one thing in the power of art or nature, that would so generally and effectually contribute to repair the constitutions of our gentry and nobility, by strengthening the children, and casting off, in their infancy, those impurities and taints which they often bring into the world.

An infant may take one quarter of a pint in the day, warm,

by spoonfuls, less may do good, and there is no fear of excess. When I consider the private woe of families, as well as the public loss, occasioned by the death of such an incredible number of infants under two years of age, I cannot but insist on recommending tar water, both as a remedy and preservative in that tender age, which cannot bear the common treatment and methods of physic, or with safety take those drugs which are fitter for grown persons.

Another reason which recommends tar water, particularly to infants and children, is the great security it brings against the small-pox, to those that drink it, who are observed, either never to take that distemper, or to have it in the gentlest manner.

There is no distemper more contagious and destructive than the small-pox, or more generally dreaded, attended with worse symptoms, or that leaves behind it worse effects; I observe, at the same time, that tar water is in no other case a more safe and sure remedy than in this; of which captain Drape's certificate, sworn to before the mayor of Liverpool, in the presence of several principal persons of that town, is a most evident proof.

That one hundred and seventy persons, seized at once with the small-pox, deprived of all conveniencies, and in the worst circumstances of a narrow ship and hot climate, should all recover by the single medicine of tar water, except one, who would not drink it, is a matter of fact, so plain and convincing, and so well attested, as to leave no doubt in minds free from prepossession, about the usefulness and efficacy of tar water in the small-pox; a point I had been before sufficiently convinced of, by many instances in my own neighbourhood.

It hath been surmised by some celebrated physicians, that one day a specific may be discovered for the peculiar venom of the small-pox. There seems to be some reason for thinking, that tar water is such a specific. I say this on good grounds, having by many experiments observed its virtue in curing, as well as in preventing, that cruel distemper; during the whole course of which, it is to be drank warm; a moderate glass (about half a pint) every hour, in common cases, may suffice, in bad cases more may be given; there is no fear of excess.

Those who endeavour to discredit this cooling, cordial, and salutary medicine, as an inflamer of the blood, do very consistently decry its use in the small-pox; but there can be nothing more clear, full, and satisfactory than captain Drape's affidavit, to convince reasonable people of the great and surprising efficacy of tar water, in the cure of the small-pox; and consequently of the groundlessness of that report, which ascribes a heating or inflaming quality to it. And yet that groundless report hath hindered many from reaping the benefit they might otherwise have done, from the use of this water, which is of excellent virtue

in all kinds of inflammatory disorders, fevers, quinsies, pleurisies, and such like of the hot and inflamed kind, whereof the public as well as myself have known a multitude of examples.

I ask whether the fact sworn before the magistrates of Liverpool be not a sufficient answer to all that is objected, from an inflaming quality to tar water. Can any instance be produced in the whole *materia medica*, or history of physic, of the virtue of a medicine tried on greater numbers, or under greater disadvantages, or with greater success, or more credibly attested. I wish for the common good of mankind, that the same experiment was tried in our hospitals. Probably the world would soon be relieved from that great and general terror of the small-pox.

When I hear of the devastations made by this distemper in great cities and populous towns, how many lives are lost, or (as may be said) thrown away, which might have been in all likelihood easily preserved, by the use of a medicine so cheap and obvious, and in every one's power, it seems matter of great concern and astonishment, and leaves one at a loss to guess at the motives that govern human actions in affairs of the greatest moment. The experiment may be easily made, if an equal number of poor patients in the small-pox, were put into two hospitals at the same time of the year, and provided with the same necessaries of diet and lodging, and for further care, let the one have a tub of tar water and an old woman, the other hospital what attendance and drugs you please.

In all obstinate sores and ulcers I very much recommend the drinking of tar water, and washing them with a strong lotion of it will hasten the cure.

One of the most painful and dangerous cases is that of a woman's sore breast. How many poor creatures after long languishing in misery, are obliged to suffer the most severe chirurgical operations, often the cutting off the entire breast? The use of tar water in those cases hath been attended with such success, that I do earnestly recommend the drinking thereof, both as a cure and preservative, as a most effectual medicine to remove the shooting pains that precede a cancer, and also to cure the cancer itself, without amputation. Cancerous and sore breasts are such cruel cases, occasioned by so many internal causes, as well as outward accidents, that it is a necessary piece of humanity, to contribute all we can to the prevention and cure thereof.

In the king's evil, leprosy, and foulest cases, tar water cannot be too much recommended. The poor vagabonds of Ireland are many of them infected and eaten up with the foul disease, which with them passeth for a canker (as they call it). Several instances of extraordinary cures have been performed on such persons, by drinking tar water copiously, for some weeks or

months together, without confinement or other restraint than that of a regular cool diet. It is indeed a specific, both for this and all other taints and impurities of the blood.

An extract of Siris was made, and accounts of the effects of tar water were reprinted in America, in which continent, as well as in the islands, much use hath been made thereof, particularly by those who possess great numbers of slaves; of this I have been informed by letters, and by word of mouth, from persons belonging to those parts, who have assured me of the extensive and successful use of this medicine in many cases, and more especially in the most inveterate kinds of the foul disease.

I need not say how dearly they purchase health who obtain it by salivation, and yet long and severe as the course is, it is often unsuccessful. There are instances of such as having passed through it with much misery and patience, have been afterwards cured by the simple use of tar water.

The king's evil, so loathsome in its symptoms and effects, and withal so difficult, if at all possible to cure by any other method, is most surely and easily cured by the tar water, even when the patient is far gone, even when he derives it from his ancestors. A quart *per diem* for a few months I have known to cure the most deplorable and abandoned cases.

How many wealthy families, otherwise at their ease, are corrupted with this taint in their blood? How many want heirs and husbands through this odious malady? A specific for this disease alone would be justly esteemed a most valuable secret, and the plenty and cheapness of the medicine ought not in reason to make it less esteemed.

Salivating, bleeding, and purging, are attended with great hardships and inconveniencies (even where the patient recovers), reducing the strength and spirits of those who use them, whereas tar water greatly adds to both.

In fractures and wounds, a quart drank daily, while the patient is under cure, doth very much assuage the pain and promote his recovery, both as by its balsamic nature it disposeth the parts to heal, and also as it lessens if not totally prevents the fever.

A poor boy in Cloyne, having fallen from a tree, broke both arm and wrist. This accident was concealed or neglected for two or three weeks, he was then put under the care of a skilful bone setter, who finding the bones knit and grown crooked, and that it would be necessary to break them again, in order to set them right, and withal considering the hot season of the year (in July) he apprehended his patient's being thrown into a fever that might prove fatal. But the boy being made to drink copiously of tar water, this prevented or lessened the fever in such sort, that the bones were broke and set again, and the cure proceeded as easily and speedily as could be wished.

I have known several instances of bruises and wounds cured by tar water. A person in my neighbourhood ran over by a horse was much bruised, and cured only by drinking tar water. Another knocked down by a mallet, thereupon thrown into a violent fever, and given for dead; another wounded with an axe, so that his life was thought in danger, were both recovered by the use of tar water; which, as it is sovereign against gangrenes and fevers, hath great success in all sorts of wounds, contusions, and fractures, being taken throughout the whole chirurgical process, alone with whatever other methods or remedies are applied.

Tar water operates variously. In dropsies and bruises it hath been known to work by purging. The stronger kind, being used as a wash, is good against ulcerous eruptions. But in all cases where the lotion is used, I believe the drinking of tar water might alone suffice, albeit the sores may be longer withering and drying away.

There is a certain age or time of life when the female sex runs no small risk from the ceasing of their natural evacuations. In this case tar water is a good preservative, purifying the blood, and clearing it from that cancerous tendency which it is sometimes subject to about that time. I take it to be a specific in all cancerous cases; even the bleeding cancer, esteemed incurable by physicians, hath been cured by tar water.

In diseases peculiar to women it is of no small use. Several who had suffered much by accidents in child-bearing, have found themselves relieved by tar water. In all sorts of tumours, wens, and preternatural excrescences, it hath been found an excellent remedy.

Many dangerous symptoms, and even sudden death, are often owing to a polypus in some or other of the vessels through which the blood circulates, than which it seems there is no inward cause of death or disease more to be dreaded and guarded against. How many drop down dead in our streets, or at table, or in the midst of business or diversions! How many are found dead in their beds!

Tremors, palpitations of the heart, irregular pulses, apoplexies, sudden deaths, often proceed from a slow, stagnating, interrupted motion, or stoppage of the blood, in its circulation through the body; and there seemeth to be no cause so certainly productive of obstructed circulation as the polypus, a case, perhaps, much more frequent than is commonly imagined. Morgagni, the celebrated professor at Padua, and most eminent anatomist, who was supposed to have dissected more human bodies than any man living, assured me, above thirty years ago, that in the far greater part of such bodies he found polypuses, if not in the ventricles of the heart or larger vessels, yet in some other vessel or cavity; to which he attributes many disorders, and which he supposed to

be formed by the obstructed motion of the blood. To prevent this, he dissuaded from all tight ligatures, especially in sleep, unbuttoning the neck and wrist bands of his shirt every night, a practice he had learned, as he said, from his master, the famous Malpighi.

When the circulation is once quite stopped nothing can restore it, which would be the same thing as restoring a dead man to life, and in proportion as the circulation of the blood is obstructed, the body is disordered. Total obstruction is death; partial obstruction is disease. The polypus, therefore, is always hurtful, if not mortal. It is, indeed, matter of serious reflection, that we may probably carry about with us a principle of death, always at work within, and of a nature so violent and sudden in its effects, so hard to come at, and so difficult to subdue.

It may well be thought at first view, a vain undertaking to attempt to dissolve a fleshy or membranous substance, so latent and inaccessible, by common means or medicines. But, as tar water hath been undoubtedly known to dissolve and disperse wens, and other fleshy or membranous tumours, in the outward parts of the body,* having been drank and circulated with the blood, it should seem by a parity of reason, that it may also dissolve and put an end to those concretions that are formed in the ventricles of the heart or blood vessels, and so remove one great cause of apoplexies and sudden death; and what cures may prevent. I have been the longer on this subject, for the sake of many who lead sickly lives, as well as several who are snatched away by untimely death.

Universally, in all cases where other methods fail, I could wish this of tar water was tried. It hath been sometimes known, that the most inveterate head-aches, and other nervous disorders, that would yield to no other medicine, have been cured by a course of tar water, regularly and constantly pursued.

Wheresoever pure blood or plenty of spirits are wanting, it may be concluded from manifold experience, that tar water is of singular benefit. Several persons have acknowledged themselves to be much fitter to go through business or study from the use of it.

Nor is it only medicinal to human kind; it is also of no small use in the curing of brute animals. It hath been tried on several kinds, particularly with great success in the late epidemical distemper of our horses. And I have been credibly informed, that being drank in plenty, it hath recovered even a glandered horse that was thought incurable.

And as it is of such extensive use, both to man and beast, it should seem that a tub of tar water constantly supplied in a market town, would serve in some sort for an hospital. Many

* See the effects of tar water, sect. 228, 229.

other drugs are not easily got, this is every where plentiful and cheap; many are of a doubtful nature, this of known innocence; others soon perish, this lasts for years, and is not the worse for keeping. This, in short, is a medicine for the common people, being a safe and cheap remedy for such as cannot afford to be long sick, or to make use of costly medicines.

A patient who drinks tar water must not be alarmed at pustules or eruptions in the skin; these are good symptoms, and show the impurities of the blood to be cast out. It is also not amiss to observe, that, as tar water, by its active qualities, doth stir the humours, entering the minutest capillaries, and dislodging obstructions, it may happen that this working shall sometimes be felt in the limbs, or discharge itself in a fit of the gout, which, however disagreeable, proves salutary.

I am credibly informed of several strange conveyances which tar water hath found out, whereby to discharge impurities from the human constitution. A person who had been in a bad state of health above twenty years, upon a course of tar water was thrown into a most extraordinary fit of an ague, and from that time recovered a good state of health. An old gentleman in the county of Cork, who for a long time had been a valetudinarian, afflicted with many infirmities, being advised to drink tar water, found himself relieved; but it produced and soon cured a pthiriasis, or lousy distemper, in which the putrid humours having discharged themselves, left him quite sound and healthy.

In a course of tar water, if any disorder happens from some other cause, as from cold, from the use of strong liquors, from a surfeit, or such like accident, it would not be fair to impute it to tar water; and yet this hath been sometimes done.

The effects of vomiting occasioned by tar water are not to be apprehended. Some are discouraged from drinking because their stomachs cannot bear it. But when it takes a turn towards working upwards, nature, by that very way, hath been often known to carry on the cure. A worthy gentleman, member of parliament, came into my neighbourhood in the autumn of the year 1750; he was cachectic and extremely reduced, so that his friends thought him near his end. Upon his entering into a course of tar water, it produced a prodigious vomiting, which weakened him much for the present; but persisting to continue the use thereof for about two months, he was restored to his health, strength, and spirits.

Tar water is very diuretic, thereby preventing stone and gravel, and carrying off by urine, those salts that might otherwise occasion fevers, rheumatisms, dropsies, head-aches, and many other disorders, if retained in the blood. Hence, some have apprehended a diabetes, from the continued use thereof, but it is so far from causing a diabetes, that it hath been known to cure that disorder.

The constitution of a patient sometimes requireth during a course of tar water, that he take water and honey, also roasted apples, stewed prunes, and other diet of an opening kind. A hint of this is sufficient. If the reader now and then meets with some remarks, contained in my former writings on this subject, he may be pleased to consider, I had rather repeat than forget what I think useful to be known.

Some, endeavouring to discourage the use of tar water in England, hath given out that it may indeed be serviceable in Ireland, where people live on such low diet as sour milk and potatoes, but it cannot be of the same service in England, where men are accustomed to a more liberal and hearty food; and indeed it must be owned, that the peasants in this island live but poorly, but no people in Europe live better (in the sense of eating and drinking) than our gentry and citizens; and from these the instances of cures by tar water have been chiefly taken. Those who would confine its use to the moist air and poor diet of Ireland, may be assured that all over Europe, in France, and Germany, Italy, Portugal and Holland, tar water works the same effects. In both North and South, in West and East Indies, it hath been used, and continues to be used with great success. It hath reached all our colonies both on the continent and the islands, and many barrels of tar water have been sent from Amsterdam to Batavia; of all which I have had authentic accounts. But its use is no where more conspicuous than at sea, in curing that plague of seafaring persons, the scurvy, as was found in the late attempt to discover a north-west passage; and (as I doubt not) will be found as oft as it is tried. Every ship in his majesty's navy should always have a vessel of tar water upon deck, for the use of the sailors, both in the scurvy and other maladies.

It is indeed a medicine equally calculated for all climates, for sea and land, for rich and poor, high and low livers; being, as hath been elsewhere mentioned, a cordial which doth not heat; a peculiar privilege this, and of excellent use. That it is a cordial, is manifest from its cheering and enlivening quality, and that it is not heating, is as manifest, from its singular use in all cases where the blood is inflamed. As this medicine imparts a genial friendly warmth, suited to the human constitution, those who pass through a course of tar water, would do well not to increase such friendly warmth to an inflaming heat, by a wrong regimen of high seasoned food and strong liquors, which are not wanted by the drinkers of tar water. There is a certain degree of heat necessary to the well-being and life of man. More than this will be uneasy, and this uneasiness indicates a proper choice of diet.

I have myself drank above a gallon of tar water in a few

hours, and been cooled and recovered from a fever by it. So many instances of the same nature I have known, as would make it evident to any unprejudiced person, that tar water is a cooling medicine; of which truth I am as thoroughly convinced, as it is possible to be of any theorem in physic or natural science.

The unsuccessfulness of other methods should rather be an encouragement than a bar to the trial of tar water. A young lady, daughter to a worthy gentleman near Cork, had been long afflicted with a grievous pain in her side, and having had the best advice that could be got, was not relieved until she drank tar water, which quite removed her pain. Some time after she was again seized with the same disorder, but returning to the use of tar water, she grew well, and still continues so.

A woman turned out of the infirmary at Cork, as incurable, because she would not submit to the cutting off her leg, came to Cloyne, where she continued half a year drinking tar water, and living upon bread and milk, by which course she recovered, and went to service.

There is at present, while I am writing, a most remarkable case here at Cloyne, of a poor solder in a dropsy, whose belly was swollen to a most immoderate size. He said he had been five months in an hospital at Dublin, and having tried other methods in vain, left it to avoid being tapped. It is a fortnight since he came to Cloyne, during which time he hath drank two quarts of tar water every day. His belly is now quite reduced: his appetite and sleep which were gone are restored: he gathers strength every moment: and he who was despaired of seems to be quite out of danger, both to himself, and to all who see him. It is remarkable, that upon drinking the tar water, he voided several worms of a very extraordinary size. This medicine, which is observed to make some persons costive, is to hydropic patients a strong purge. The present is but one of several instances, wherein the dropsy hath been cured by tar water; which I never knew to fail in any species of that malady.

I am very credibly informed, that an aged clergyman of Maidstone in Kent, being reduced to the last extremity by the gout in his stomach, after having tried strong liquors, and the methods usual in that case without success, betook himself to drink a vast quantity of warm tar water, still replenishing and letting it take its course; by which it pleased God to deliver him from the jaws of death.

A gentleman in the county of Clare, near Ennis, had a fever and pleurisy, and inflammation of the lungs, being at the last extremity, and given over by two physicians, he was advised to drink tar water, which he did eight quarts. Next morning one of the doctors asking at what hour his patient died? to his great surprise found he was recovered. This I had from a parliament man his neighbour.

When the yellow fever (as it was called) raged in the West Indies, the negroes, with a tub of tar water in their quarters, did well: but some of the better sort miscarried, among whom the physician himself lay at the point of death; but his brother recovered him by pouring down his throat in spoonfuls, some of the same liquor that recovered the negroes. The fact was related to me by a gentleman who was then in the island of St. Christopher's, and knew it to be true.

A physician himself, not long since assured me, he had cured an ulcer in the bladder, by ordering his patient to drink tar water, when he had tried all other methods in vain, and thought the case incurable.

But it would be endless to relate the effects of tar water in desperate cases. The recovery of Mrs. Wilson, daughter to the late bishop of London, from a lingering hopeless disorder, was a noted case, and attested to by his lordship. I have even been informed upon good authority, of two or three instances, wherein persons have been recovered by tar water, after they had rattles in the throat.

In certain cases, a smaller quantity of tar water hath proved ineffectual, when a larger hath perfected the cure. A woman of Cloyne got cold after child-bearing, which occasioned a great pain in her thigh, swelling also, and redness; she continued in great torment above three weeks. She then began to drink tar water, but not drinking much she did not perceive much good; and when there was not any hopes of her life, she was persuaded to try what a gallon a day might do, upon this she grew better, the swelling broke and ran; no dressing was used but tar, and no washing but tar water, until she was quite recovered.

In ailments of an odd and untried nature, it may be worth while to try tar water. In proof of this many instances might be given. A gentleman with a withered arm had it restored by drinking tar water. Another who, by running his head against a post, had a concussion of the brain attended with very bad symptoms, recovered by drinking tar water after other medicines had failed. In my own neighbourhood, one had lost the use of his limbs by poison, another had been bitten by a mad ass; these persons drank tar water, and their cure was attributed to it.

When tar water is copiously drank in fevers, the great danger to be guarded against, is an excessive flow of spirits, which excites the patient to talk and divert himself with company, which may produce a relapse; of this I have known fatal effects.

If in a course of tar water, the patient should find himself heated, let him abstain from, or lessen his dose of, spirituous and fermented liquors; for tar water alone never heats.

In chronical disorders it is not advisable to break off a course of tar water at once, but rather to diminish the quantity by degrees.

The acid alone hath not the medicinal virtues of tar water. This is agreeable to reason and experience, as well as the opinion of the ablest judges. Doctor Linden justly observes, "that when the empyreumatic oil is entirely separated from the acid, it is not in any shape superior to any other distilled acids or vinegars whatsoever."—*Treatise on Selter Water*, p. 307.

* That extraordinary virtues should be contained in tar water, will not seem strange, if we consider that pitch is nothing else but hardened tar, or tar drained of its moisture; and that an extraordinary quantity of light is retained in the substance of pitch, as appears from certain electrical experiments, which, having been made since, seem not a little to confirm what had before been suggested in Siris.

* Something of this nature hath been long expected and hoped for, if we may credit that learned chymist Doctor Linden, "at last (saith he) the long delayed wishes of the most eminent men of the faculty are fulfilled, in the Bishop of Cloyne's discovery."—See *Treatise on Selter Water*, p. 303. Again (speaking of empyreumatic oils of plants) he hath these words, "There has always prevailed a notion among the chymists, and particularly with Paracelsus and his followers, that in those oils there lay a great secret undiscovered. This notion was occasioned by the strange effects which a small quantity thereof hath upon the human machine. Several have been very diligent to discover this secret, and to find out a method to administer these oils with safety; yet nothing was performed salutary, until the Bishop of Cloyne discovered to us the tar water, to him alone we are indebted for rendering the empyreumatic oils a safe medicine in every respect."—*Ibid.* p. 302.

THE END OF VOL. II.

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